MIAMI-DADE AVIATION DEPARTMENT

MIAMI-DADE COUNTY

VOLUME III
TECHNICAL SPECIFICATIONS

MIAMI OPA-LOCKA EXECUTIVE AIRPORT
RUNWAY 9L-27R REHABILITATION

ISSUED FOR BID

MDAD Project No. X009A
FAA AIP # 3-12-0047-019-2021
CONTRACT # E16-MDAD-03, SO-08

Prepared by

ATKINS
Member of the SNC-Lavalin Group

Technical Specifications

Item P-101 Preparation/Removal of Existing Pavements

DESCRIPTION

101-1 This item shall consist of preparation of existing pavement surfaces for overlay, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

EQUIPMENT AND MATERIALS

101-2 All equipment and materials shall be specified here and in the following paragraphs or approved by the Resident Project Representative (RPR). The equipment shall not cause damage to the pavement to remain in place.

CONSTRUCTION

101-3.1 Removal of existing pavement.

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

a. Concrete pavement removal. The Contractor shall break the existing concrete in-place for removal or may sawcut and lift the slabs off. The removed concrete shall be disposed off airport property.

b. Asphalt pavement removal. Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed. Asphalt pavement shall be removed by milling in accordance with paragraph 101-3.5.

c. Repair or removal of Base, Subbase, and/or Subgrade. All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the RPR. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

101-3.2 Preparation of joints and cracks prior to overlay. After milling, the Contractor shall evaluate remaining cracks and/or paving joints with the RPR and Engineer to determine which cracks/joints require sealing. Crack/joint sealing work shall not progress until direction is provided by the RPR and Engineer.

Remove all vegetation and debris from cracks to a minimum depth of 1 inch. If extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide approved by the RPR. Fill all cracks greater than 1/4 inch wide with a crack sealant per ASTM D6690. The manufacturer shall provide certification that the crack sealant, preparation, and application shall be compatible with the surface treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the crack sealant a minimum of 1/8 inch, not to exceed ¼ inch. Any excess joint or crack sealer shall be removed from the pavement surface. The sealant manufacturer's representative shall be on-site for the first day of joint/crack preparation and sealing. The representative shall ensure that the preparation and sealant is in accordance with the manufacturer's installation recommendations.

101-3.3 Removal of Foreign Substances/contaminates prior to overlay. Removal of foreign substances/contaminates from existing pavement that will affect the bond of the new treatment shall consist of removal of rubber, fuel spills, oil, crack sealer, at least 90% of paint, and other foreign substances from the surface of the pavement. Areas that require removal are designated on the plans and as directed by the RPR in the field during construction. If chemicals are used, they shall comply with the state's environmental protection regulations. Removal methods used shall not cause major damage to the pavement, or to any structure or utility within or adjacent to the work area. Major damage is defined as changing the properties of the pavement, removal of asphalt causing the aggregate to ravel, or removing pavement over 1/8 inch (3 mm) deep. If it is deemed by the RPR that damage to the existing pavement is caused by operational error, such as permitting the application method to dwell in one location for too long, the Contractor shall repair the damaged area without compensation and as directed by the RPR. Removal of foreign substances shall not proceed until approved by the RPR. Water used for high-pressure water equipment shall be provided by the Contractor at the Contractor's expense. No material shall be deposited on the pavement shoulders. All wastes shall be disposed of in areas indicated in this specification or shown on the plans.

101-3.4 Concrete spall or failed asphaltic concrete pavement repair.

a. Repair of concrete spalls in areas to be overlaid with asphalt. Not used.

b. Asphalt pavement repair. The Contractor shall repair asphalt pavement as directed by the RPR. The failed areas shall be removed as specified in paragraph 101-3.1b. All failed material including surface, base course, subbase course, and subgrade shall be removed. Materials and methods of construction shall comply with the applicable sections of these specifications.

101-3.5 Cold milling. Milling shall be performed with a power-operated milling machine or grinder, capable of producing a uniform finished surface. The milling machine or grinder shall operate without tearing or gouging the underlaying surface. The milling machine or grinder shall be equipped with grade and slope controls, and a positive means of dust control. All millings shall be removed and disposed on a facility properly designated for the disposal of contaminates & foreign substances (Class I Landfill). If the Contractor mills or grinds deeper or wider than the plans specify, the Contractor shall replace the material removed with new material at the Contractor’s Expense. The milled surface shall be dry and clean prior to application of tack coat.

The Contractor shall submit a milling plan to the RPR for review and approval a minimum of 14 days prior to beginning the work. The milling plan shall include the following items:

- Make and model of the milling machine(s) and clean up equipment to be used.
- Method of grade control.
- A tabulation of the pavement elevations after milling corresponding to the grid shown on the pavement elevation plans.
- A milling plan indicating the location, sequence, and width of each milling lane to be used. Provide an estimate of the daily production.

The Contractor shall sequence the milling to protect the existing pavement to remain. Hauling on previously milled surfaces shall be limited to the runway, do not route traffic on the milled shoulders.

a. Patching. The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The RPR shall layout the area to be milled with a straightedge in increments of 1-foot widths. The area to be milled shall cover only the failed area. Any excessive area that is milled because the Contractor doesn’t have the appropriate milling machine, or areas that are damaged because of his negligence, shall be repaired by the Contractor at the Contractor’s Expense.

b. Profiling, grade correction, or surface correction. The milling machine shall have a minimum width of 7 feet and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch of the specified grade. Areas that are over-milled over the 1/4 inch tolerance shall be replaced at the Contractor’s expense. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck. All millings shall be removed and disposed of off the airport.

The Contractor shall survey the milled surface at the grid shown on the pavement elevation plans to verify grades are within tolerance. If scabbing occurs, the Contractor shall inform the RPR and define the limits and depth of scabbing below the specified grade. Scabbing is defined as additional asphalt removed below the depth of milling due to proximity to an existing lift interface.

Scabbing shall be repaired at the RPR's direction and may include additional milling to place a lift of asphalt prior to the 4 inches shown on the Plans or may allow the first lift to be placed variable thickness to fill the scabbed location. Additional milling directed by the RPR shall be at no additional cost. The additional asphalt will be paid in accordance with pay items P-401-8.1 and P-403-8.1. Additional tack coat required to correct scabbing shall be incidental to the work.

c. Clean-up. The Contractor shall sweep the milled surface daily and immediately after the milling until all residual materials are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep and/or blow the surface to remove loose residual material. Waste materials shall be collected and removed from the pavement surface and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed off Airport property.

101-3.6. Preparation of asphalt pavement surfaces prior to surface treatment. Not used.

101-3.7 Maintenance. The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the RPR. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed at the Contractor's expense.

101-3.8 Preparation of Joints in Rigid Pavement prior to resealing. Not used.

101-3.9 Preparation of Cracks in Flexible Pavement prior to sealing. Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. Immediately before sealing, cracks will be blown out with a hot air lance combined with oil and water-free compressed air. The Contractor shall demonstrate, in the presence of the RPR, that the method used cleans the cracks and does not damage the pavement.

METHOD OF MEASUREMENT

101-4.1 Full-Depth Concrete Pavement Removal. The unit of measurement for full-depth concrete pavement removal shall be the number of square yards removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal.

101-4.2 Full-Depth Concrete and Asphalt Pavement Removal. The unit of measurement for full-depth concrete and asphalt pavement removal shall be the number of square yards removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal.

101-4.3 Full-Depth Asphalt Pavement Removal. The unit of measurement for full-depth asphalt pavement removal shall be the number of square yards removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal.

101-4.4 Variable Depth Asphalt Milling. The unit of measurement for variable depth asphalt milling shall be the number of square yards milled by the Contractor. Any pavement milled outside the limits of milling because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to milling.

101-4.5 Surface Crack Preparation and Sealant. The unit of measurement for surface crack preparation and sealant shall be the number of linear feet prepared and sealed by the Contractor..

BASIS OF PAYMENT

101-5.1. Full-depth concrete pavement removal payment shall be made at the contract unit price per square yard. This price shall be full compensation for full-depth demolition of the existing concrete and underlying soil to the depth required to install the proposed pavement. This price shall also be inclusive of removal, hauling, and disposal of the demolished materials and for all labor, equipment, tools, and incidentals necessary to complete this item.

101-5.2. Full-depth concrete and asphalt pavement removal payment shall be made at the contract unit price per square yard. This price shall be full compensation for full-depth demolition of the existing asphalt, concrete, and underlying soil to the depth required to install the proposed pavement. This price shall also be inclusive of removal, hauling, and disposal of the demolished materials and for all labor, equipment, tools, and incidentals necessary to complete this item.

101-5.3. Full-depth asphalt pavement removal payment shall be made at the contract unit price per square yard. This price shall be full compensation for full-depth demolition of the existing asphalt and underlying limerock base and soil to the depth required to install the proposed pavement. Temporary stockpiling of the limerock base for reuse is incidental to this item. This price shall also be inclusive of removal, hauling, and disposal of the demolished materials (including excess limerock base, if any) and for all labor, equipment, tools, and incidentals necessary to complete this item.

101-5.4. Variable depth asphalt milling payment shall be made at the contract unit price per square yard. This price shall be full compensation for milling existing asphalt pavement to the depth(s) shown on the plans. Additional removal to correct scabbing, as directed by the RPR, is incidental to this item and will not be measured or paid separately. This price shall also be inclusive of removal, hauling, and disposal of the asphalt millings and for all labor, equipment, tools, and incidentals necessary to complete this item.

101-5.5. Surface crack preparation and sealant payment shall be made at the contract unit price per linear foot. This price shall be full compensation for preparing and sealing existing cracks and joints in the asphalt pavement. This price shall also be inclusive of all labor, equipment, tools, and incidentals necessary to complete this item.

Item P 101-5.1	Full-Depth Concrete Pavement Removal - per square yard
Item P 101-5.2	Full-Depth Concrete and Asphalt Pavement Removal – per square yard
Item P 101-5.3	Full-Depth Asphalt Pavement Removal – per square yard
Item P-101-5.4	Variable Depth Asphalt Milling - per square yard
Item P-101-5.5	Surface Crack Preparation and Sealant - per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5380-6	Guidelines and Procedures for Maintenance of Airport Pavements.

ASTM International (ASTM)

ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF ITEM P-101

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Item P-151S Clearing and Grubbing
SUPPLEMENT

The work to be performed under the classification of Clearing, Grubbing and Demolition shall meet the requirements of Section P-151 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

DESCRIPTION

ADD the paragraph below**.**

See Item P-101 Preparation/Removal of Existing Pavements for supplemental requirements for the preparation of existing pavement surfaces for overlay, removal of existing pavement, and other miscellaneous items.

CONSTRUCTION METHODS

Add at the end of article 151-2.5 DEMOLITION OF PAVEMENT, the following language:

Contractor must comply with all the requirements in Item P-101 Preparation/Removal of Existing Pavements

Add article151-2.6 **BLASTING**

151-2.6 Blasting. Blasting shall not be allowed.

METHOD OF MEASUREMENT

DELETE article 151-3.2 and **INSERT**:

151-3.2 No separate measurement of demolition of structures for payment of structures demolished complete and accepted in accordance with the Plans and the Specifications will be made.

Delete article 151-3.3 and **INSERT**:

151-3.3 Measurement of demolition of pavements for payment shall per METHOD OF MEASUREMENT under Item P-101 Preparation/Removal of Existing Pavements

BASIS OF PAYMENT

Delete entire article 151-4 and **INSERT**:

151-4.1 Payment for the quantities of clearing and grubbing, measured as described above shall be made at the Contract Unit Prices Bid for Clearing and Grubbing, , which prices and payment shall be full compensation for furnishing all labor, materials, equipment, processes, tools and incidentals necessary to complete the work under this Section.

151-4.2 No separate payment for Demolition of Structures.

151-4.3 Payment for Demolition of Concrete and Bituminous Pavement shall be per Item P-101 Preparation/Removal of Existing Pavements, BASIS OF PAYMENT paragraphs P-101-5.1, P-101-5.2, P-101-5.3, P-101-5.4, and P-101-5.5.

Payment will be made under:

Item P-151-4.1	Clearing and grubbing - per acre

END OF ITEM P-151

SECTION P-151 CLEARING, GRUBBING AND DEMOLITION

DESCRIPTION

151-1 The work specified in this section consists of the clearing, grubbing, demolition and disposal of all material and debris, for the areas designated on the Plans or as directed by the Architect/Engineer.

CONSTRUCTION METHODS

151-2 GENERAL. The areas shown on the Plans to be cleared, grubbed and demolished under this Section shall be staked by the Contractor and approved by the Architect/Engineer before work begins. The clearing, grubbing and demolition shall be done well in advance of grading, stripping or other operations as approved by the Architect/Engineer.

All materials and debris, except for material to be salvaged for the airport's use as specified below, obtained from the clearing, grubbing and demolition operations shall be removed and legally disposed of by the Contractor in commercial disposal areas. The Contractor shall not burn, or otherwise dispose of any unsalvageable materials or debris anywhere within the Airport property.

All removed limerock and soil, including organic soil materials, shall be salvaged for the airport's future use and shall be stockpiled in areas shown on the Plans or as directed by the Architect/Engineer. Removal of limerock will be as specified in Section P-152.

The Contractor shall provide disposal areas outside of the airport property limits for the disposal of materials not intended for salvage for the airport's use. If the Contractor intends to use a private disposal area, he shall obtain and file with the Architect/Engineer, the property owner's written permission, for the use of such property.

Whenever any above or below ground communications facility, pipeline, conduit, sewer, drain, or any other utility not depicted on the Plans is encountered which must be either removed or relocated, the Contractor shall promptly advise the Architect/Engineer of this condition, who will then either order the Contractor to proceed with the necessary Extra Work, and payment therefore will be made under the General Allowance Account or under a Change Orders in accordance with the requirements of the General Conditions, or he will notify the proper local authority or owner to secure remedial action.

151-2.1 CLEARING AND GRUBBING. Clearing and grubbing shall consist of clearing the surface of the ground, canal banks and bottom of canals of all trees, stumps, roots, matted roots, down timber or wood, logs, snags, boulders, unsuitable soil, silt, brush, undergrowth, underwater growth, hedges, and heavy growth of grass or weeds and the proper disposal of such materials.

151-2.3 DEMOLITION OF STRUCTURES. Demolition shall consist of the removal and disposal from the site of fences, gates, buildings, abandoned materials, construction debris, curbs, gutters, sidewalks, headers, retaining walls, asphalt and concrete pavements, above and below ground structures and utilities, foundations, foundation cut off, drainage or utility structures and pipes or other appurtenances, utility poles, general debris, clean-up, and rubbish of any nature. The work shall also include utility modifications, utility disconnects, cut and patch walls and slabs in structures to remain as required, all in conjunction with the removal of buildings and structures under this Section.

151-2.4 BACKFILLING. Any holes or openings remaining in the subgrade or existing pavement shall be backfilled with acceptable materials and properly compacted, as specified in these Technical Specifications.

All holes remaining after the grubbing and demolition operation within embankment areas is completed, shall have the sides broken down to flatten out the slopes, backfilled with suitable backfill material, and compacted in layers as required in Section P-152 of these Technical Specifications. The same construction procedure shall be applied to all holes located within excavation areas and remaining after grubbing and demolition is completed, where the depth of holes exceeds the depth of the proposed excavation.

151-2.5 DEMOLITION OF PAVEMENT. In paved areas to be demolished the bituminous or concrete pavement materials shall be scarified and/or broken into pieces, using approved equipment and shall be removed and disposed of in accordance with the requirements of Article 151-2.1.

To avoid damaging existing underground utilities, the use of drop hammers or wrecker balls to break Portland Cement (P.C.) concrete pavement slabs will not be permitted.

The Contractor shall, unless otherwise approved by the Architect/Engineer, begin breaking the P.C. pavement slab near its center, then proceed breaking the slab uniformly toward its outer edges.

When the work requires the partial removal of a P.C. concrete pavement slab, the Contractor shall saw cut the slab, to its full depth, along the peripheral lines of the proposed removal limits using approved mechanical saws, prior to breaking the portion of the pavement slab to be removed.

METHOD OF MEASUREMENT

151-3.1 Measurement of clearing and grubbing for payment shall be the number of acres or fractions thereof *(square meters)*, actually cleared and grubbed in accordance with the Plans and Specifications.

151-3.2 Measurement of demolition of structures for payment shall be each structure demolished complete and accepted in accordance with the Plans and the Specifications.

151-3.3 Measurement of demolition of pavements for payment shall be the number of square (yards) *(meters)* of concrete pavement and the number of square (yards) *(meters)* of bituminous pavement actually demolished and accepted in accordance with the Plans and Specifications. There will be no separate measurement and payment for removal of crushed limerock base and limerock subbase material under this Section.

BASIS OF PAYMENT

151-4 Payment for the quantities of clearing and grubbing, demolition of structures and demolition of pavements measured as described above shall be made at the Contract Unit Prices Bid for Clearing and Grubbing, Demolition of Structures, Demolition of Concrete Pavement, and Demolition of Bituminous Pavement, which prices and payment shall be full compensation for furnishing all labor, materials, equipment, processes, tools and incidentals necessary to complete the work under this Section.

Payment shall be made under:

Item No.	Clearing and Grubbing	Per (Acre) *(Square Meter)*
Item No.	Demolition of Structures	Per Each
Item No.	Demolition of Concrete Pavement	Per Square (Yard)*(Meter)*
Item No.	Demolition of Bituminous Pavement	Per Square (Yard) *(Meter)*

TESTING AND MATERIAL REQUIREMENTS

Density and Materials per Specification Section P-152.

END OF SECTION

Item P-152S Excavation, Subgrade, and Embankment

SUPPLEMENT

The work to be performed under the classification of excavation and embankment shall meet the requirements of Section P-152 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

DESCRIPTION

CONSTRUCTION METHODS

DELETE the entire 152-2.2 second paragraph and **INSERT**:

The Contractor, must submit to the RPR the survey notes of the elevations and measurements of the ground surface. The Contractor and RPR shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were used to develop the design plans.

Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within 0.1 foot of the stated elevations for ground surfaces, or within 0.04 foot for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the RPR in writing at least two weeks before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the RPR. Excess topsoil, if any, shall be disposed of off airport property unless otherwise directed by the RPR. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material shall be disposed of off airport property.

The grade shall be maintained so that the surface is well drained at all times. Provide sump pumps and/or relief ditches to maintain excavations in a dry condition at all times, including during non-working hours. Trenches shall be backfilled the same day they are excavated.

Material which becomes wet and/or unstable due to the Contractor's means and methods or failure to maintain a well-drained surface at all times shall be removed and replaced with suitable material as directed by the RPR. Removal and replacement shall be in accordance with this specification and is at the Contractor's expense.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed off airport property as directed by the RPR. The Owner reserves the first right of refusal to all excavated materials and materials generated as a result of demolition. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas off airport property.

All excavation, stockpiling, and placement of material shall be conducted in accordance with the plans, specifications, and as directed by the RPR .

DELETE article 152-2.2, item a and **INSERT**:

a. Selective grading. The more suitable material designated by the RPR shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved. Excavated lime rock shall be temporarily stockpiled for use in constructing the stabilized subgrade.

DELETE article 152-2.2 ,item b and **INSERT**:

b. Undercutting. Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches below the subgrade or to the depth specified by the RPR. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed off the airport. The cost is incidental to this item. This excavated material shall be paid for at the contract unit price per cubic yard for embankment. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment and is incidental to this item. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as embankment.

DELETE article 152-2.2 ,item c and **INSERT**:

c. Over-break. Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the RPR. All over-break shall be graded or removed by the Contractor and disposed of as directed by the RPR. The RPR shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the RPR determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation."

DELETE entire article 152-2.3 and **INSERT**:

152-2.3 Borrow excavation. There are no borrow sources within the boundaries of the airport property. The Contractor shall locate and obtain borrow sources, subject to the approval of the RPR. The Contractor shall notify the RPR at least 15 days prior to beginning the excavation so necessary measurements and tests can be made by the Contractor's quality control laboratory in the presence of the RPR. Provide test results of representative samples indicating conformance with paragraph 152-1.2c a minimum of 7 days prior to incorporating the borrow material into the embankment. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.

DELETE entire article 152-2.5 and **INSERT**:

152-2.5 Preparation of cut areas or areas where existing pavement has been removed. In those areas on which a subbase or base course is to be placed, the subgrade shall be prepared in accordance with Item P-154. In unpaved areas, the top 12 inches of exposed soil shall be recompacted to not less than 95% of maximum density as determined by ASTM D1557.

ADD article 152-2.5a **PREPARATION OF EMBANKMENT**:

152-2.5a Preparation of embankment area. All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches and shall then be compacted per paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

ADD article 152-2.5b **CONTROL STRIP**:

152-2.5b Control Strip. The first half-day of construction of embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness shall be 8 inches but may be increased to a maximum of 12 inches upon the Contractor’s demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor’s expense. Full operations shall not begin until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

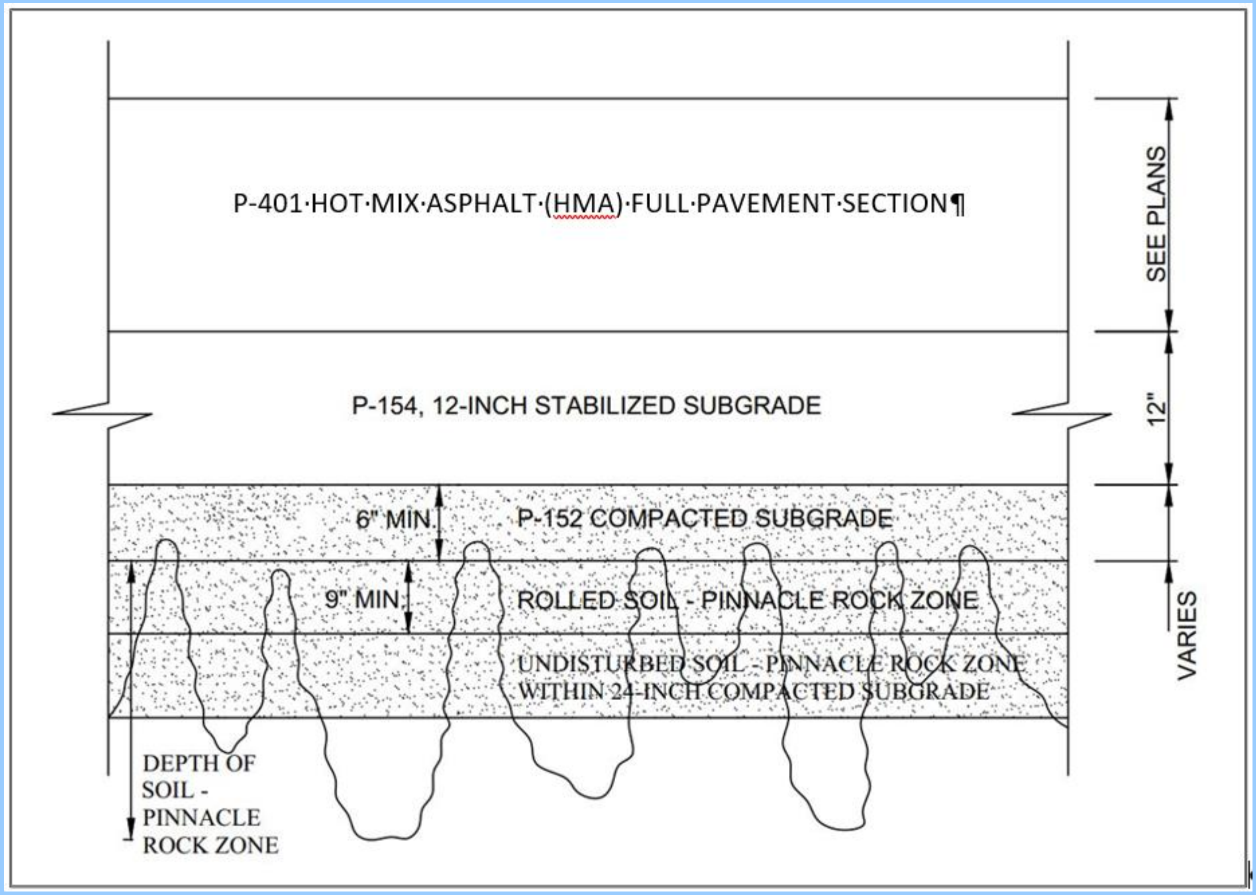
ADD article **152-2.12 PINNACLE ROCK TREATMENT**

152-2.12 PINNACLE ROCK TREATMENT. The Miami Limestone forms the bedrock in the Miami area, which includes the Miami International Airport. The Miami Limestone has been affected by karst dissolution resulting in the pinnacle surface observed at previous construction sites at the airport. The voids between the pinnacle rock is filled with loose sand and soil. Evidence of this Pinnacle Rock condition was not detected during the Geotechnical Subsurface Exploration completed for this project. Nevertheless, the Contractor shall consider in the bid price for associated Pay Items the treatment of the Pinnacle Rock if this subsurface condition is encountered during the construction process.

Location of the Pinnacle Rock Condition:

1. Flexible Pavement Section, Pinnacle Rock **Below** Stabilized Subgrade. Refer to treatment details below.
2. Flexible Pavement Section, Pinnacle Rock **In** Stabilized Subgrade. Refer to Section P-154 for treatment.

Typical Section - Pinnacle Rock Condition in P-152, Below Stabilized Subgrade



Pinnacle Rock Treatment:

1- Scarify and blend thoroughly to a depth of at least 9 inches below top of rock formation and compact the soil - rock zone using 35 to 50 ton roller at Engineer's direction. Density tests not required within soil - rock zone.
2- Build up at least a 6 inches layer of the P-152, Compacted Subgrade below the bottom of the P-154, 12-inch Stabilized Subgrade.
3- Proof roll the soil - rock zone using 35 to 50 ton roller at Engineer's direction after placing and compacting the first 6" layer of the Compacted Subgrade
4- Complete remaining P-152, Compacted Subgrade to bottom of P-154 stabilized subgrade.
5- Construct P-154, 12-inch Stabilized Subgrade and balance of the pavement section shown in the plans.

METHOD OF MEASUREMENT

DELETE articles 152-3.1, 152-3.2, 152-3.3, and152-3.4 under Method of Measurement and **INSERT**:

152-3.0 Measurement for payment specified by the cubic yard shall be computed by the comparison of digital terrain model (DTM) surfaces for computation of neat line design quantities. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by cross-sections shown on the plans, subject to verification by the RPR. After pavement demolition and clearing and grubbing, the Contractor shall survey the exposed soil to establish the original ground line for payment. The final theoretical pay line is the embankment surface prior to placement of topsoil.

No measurement or payment for embankment shall be made under proposed paved areas. Preparation of the stabilized subgrade, including any necessary borrow material for fill, is incidental to Item P-154.

All excavation under existing paved areas in incidental to Item P-101. Excavation in existing unpaved areas is incidental to Item P-152-4.1.

152-3.1 The quantity of embankment shall be the number of cubic yards measured in its final position.

152-3.2 No separate measurement will be made for Excavation. All excavation cost must be included in Pay Item P-152-4.1 Embankment - per cubic yard

152-3.3 No separate measurement will be made for Proof rolling under paragraph 152-2.11.

BASIS OF PAYMENT

DELETE article 152-4.1 under Basis of Payment and **INSERT:**

152-4.1 Embankment payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for on-site excavation in unpaved areas, obtaining borrow material from off airport property (if needed), temporary stockpiling, hauling, placement, moisture conditioning, compaction, testing, and furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item. Disposal of any unsuitable or excess excavated material is incidental to this item.

Payment will be made under:

Item P-152-4.1	Embankment - per cubic yard

INSERT the references (publications) below to article 152-5 MATERIALS AND TESTING REQUIREMENTS Section

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T-180	Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

ASTM International (ASTM)

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Advisory Circulars (AC)

AC 150/5370-2	Operational Safety on Airports During Construction Software

Software

FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design

U.S. Department of Transportation

FAA RD-76-66	Design and Construction of Airport Pavements on Expansive Soils

END OF ITEM P-152

SECTION P-152 EXCAVATION AND EMBANKMENT

DESCRIPTION

152-1.1 The work under this Section consists of excavation, disposal, placement, and compaction of all soil materials within the limits of the Contract in accordance with the Plans and Specifications or as directed by the Architect/Engineer.

152-1.2 CLASSIFICATION. All material excavated shall be classified as defined below:

a. On-Site Excavation. On-Site excavation shall consist of the excavation and disposal of all material, regardless of its nature, which is not otherwise classified. All natural soil material, including crushed or natural limerock, shall be reused in the construction or stockpiled on Airport property, as shown on the Plans, for future use by the County.

b. Borrow Excavation. Borrow excavation material shall consist of approved material required for the construction of embankment or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from existing stockpile areas within the limits of the airport property, or from borrow sources outside the airport.

c. Unsuitable Excavation. Any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod and strippings shall be considered unsuitable for use in embankment construction. Unsuitable material, when approved by the Architect/Engineer as suitable to support vegetation, may be used as topsoil dressing.

d. Contaminated Soils. Any material identified by Dade County Department of Environmental Resource Management (DERM) as contaminated soil and/or identified by the Architect/Engineer during the construction activities. Contaminated soils shall be handled, stockpiled and/or disposed of as specified in Section P-160 of the MDAD Standard Technical Specifications. Soil that has been declared reusable by DERM prior to excavation shall not be subjected to MDAD Standard Technical Specification Section P-160, unless otherwise specified by the Architect/Engineer.

152-1.3 RESPONSIBILITY. The Contractor shall be solely responsible for all work performed and quality control procedures employed under this Item.

The County will retain the services of a Professional Testing Laboratory, called hereinafter the "Project Testing Laboratory" to perform independent testing to verify the Contractor's quality control performance. The Project Testing Laboratory will perform testing at the direction of the Architect/Engineer and the Project Testing Laboratory will perform all acceptance tests. The County will pay for all testing performed by its Project Testing Laboratory.

CONSTRUCTION METHODS

152-2.1 GENERAL. Before beginning excavation, grading, and embankment operations in any area, the area shall be completely cleared and grubbed in accordance with Section P-151, except as otherwise permitted under Article 152-2.5.

The suitability of material to be placed in embankments shall be subject to approval by the Architect/Engineer. All unsuitable material shall be placed in stockpile areas located within the airport limits, or used as final dressing, or wasted in disposal areas outside the airport limits, as shown on the Plans or as ordered by the Architect/Engineer. All stockpile and waste areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of stockpile areas shall not extend above the surface elevation of adjacent usable areas of the airport, unless otherwise shown on the Plans or approved by the Architect/Engineer in writing.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The Architect/Engineer may direct the Contractor to excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Any Extra Work involved will be paid for in accordance with the provisions of Article 7 of the General Conditions.

The Contractor shall inform himself as to the character, quality, quantity, and distribution of all material to be excavated. No payment shall be made for any excavated material, which is used for purposes other than those, designated on the Plans or as described in the Specifications.

Those areas outside of the pavement areas in which the top layer of soil material has become compacted, by hauling or other activities of the Contractor shall be scarified and disked to a depth of 4 inches *(10 cm)*, in order to loosen and pulverize the soil for grassing and seeding.

If it is necessary to interrupt existing surface drainage, storm drains, or under-drainage, conduits, utilities, or similar underground structures the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services and/or arrange for their removal if appropriate, as approved by the Architect/Engineer. The Contractor shall repair all damage to such facilities or structures, which may result from any of the Contractor's operations.

The treatment of existing utilities and structures, utility disconnects and temporary utilities shall be in accordance with the provisions of the General Conditions and the Special Provisions for this Contract.

152-2.2 EXCAVATION AND STRIPPING. No excavation or stripping shall be started until the work has been staked out by the Contractor in accordance with the requirements of Section 01050 of Division 1, and the Architect/Engineer has obtained elevations and measurements of the ground surface. All suitable excavated material shall be used in the formation of embankment, subgrade, backfill, stockpiles, or for other purposes shown on the Plans. All unsuitable material shall be disposed of as specified hereinbefore.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be hauled to stockpile areas shown on the Plans. When the volume of excavation is not sufficient for constructing the fill to the grades indicated, the deficiency may be supplied from borrow sources supplied by the Contractor, or after obtaining the approval of the Architect/Engineer, the deficiency may be supplied from existing airport stockpiles, or obtained from excess excavation from other MDAD projects. Grades shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage swales or ditches shall be installed to intercept or divert surface water, which may affect the work.

a. Selective Grading. When selective grading is indicated on the plans, the more suitable material shall be used in constructing the embankment, in capping the pavement subgrade, in stabilizing subgrade courses or in other construction as shown on the Plans. If, at the time of excavation, it is not possible to place this material in its final location, it shall be temporarily stockpiled in designated areas for later use.

b. Undercutting. Rock, shale, marl, hardpan, loose rock, boulders, or other material unsatisfactory for runway safety areas, subgrades, roads, shoulders, or any areas intended for turfing shall be excavated to a minimum depth of 12 inches *(30 cm)* below the top of the proposed subgrade, or to the depths shown on the Plans.

Layers of muck, peat, matted roots, or other objectionable material, that are in the judgment of the Architect/Engineer unsatisfactory for subgrade foundation, shall be removed to the depth shown on the Plans. These unsuitable materials shall be disposed of as described hereinbefore.

The undercut area shall be backfilled with suitable material, obtained from the grading operations or stockpile areas. Backfill materials shall be placed in 8 inch *(20 cm)* layers, loose thickness, and each layer compacted to not less than 96% of maximum density, as determined by MDAD T-611, unless other compaction requirements are shown on the Plans for that backfill location. Where rock cuts are made and such areas are backfilled with suitable embankment material, any pockets created in the rock surface shall be drained in accordance with the details shown on the Plans.

The Contractor shall make the material distribution indicated on the Plans. Widening or narrowing of the section and raising or lowering of the grade to avoid haul will not be permitted. The County reserves the right to make minor adjustments and revisions in lines or grades, if found necessary as the work progresses, to obtain satisfactory construction.

Unsuitable subsoil materials found below the On-site Excavation pay limits, and up to six feet *(1.8 m)* below finished subgrade elevation, shall be excavated and disposed of in the same manner as any other unsuitable materials.

c. Overbreak. Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Architect/Engineer. All overbreak shall be restored by the Contractor.

d. Removal of Utilities. The removal of existing utilities and utility owned structures required to permit the orderly progress of work shall be accomplished by the Contractor utilizing his own forces or by subcontracting the work to the utility company in ownership. All existing foundations shall be excavated for at least 2 feet *(60 cm)* below the top of subgrade or as indicated on the plans, and the material disposed of as directed. All foundations thus excavated shall be backfilled with suitable material and compacted as specified herein.

e. Compaction Requirements. The subgrade (the term subgrade shall be understood to mean the in situ subgrade or the stabilized subgrade) under areas to be paved shall be compacted to depths and to the densities shown on the appropriate pavement sections of the Plans as determined in accordance with ASTM D 1556 and by the MDAD Standard Specification Test Section T-611. Stabilized subgrade shall be constructed as specified under Section P-154.

No payment will be made for suitable materials removed, manipulated, and replaced in order to obtain the required uniformity and depth of density shown on the Plans. Any removal, manipulation, aeration, replacement, and recompaction of suitable materials necessary to obtain the required density shall be considered as incidental to the excavation and embankment operations, and shall be performed by the Contractor at no additional cost to the County.

Stones or rock fragments larger than 3 inches *(7.5 cm)* in their greatest dimension will not be permitted in the top 12 inches *(30 cm)* of the subgrade and no stones or rock fragments larger than 4 inches *(10 cm)* will be permitted in any compacted subgrade layer. The finished grading operations, conforming to the typical cross section, shall be completed and maintained for a reasonable distance ahead of the paving operations.

In cuts, all loose or protruding rocks on the back slopes shall be removed to line 12 inches *(30 cm)* below the top of the proposed finished grade of the back slope. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Plans.

f. Blasting. Blasting or the use of explosives will not be permitted.

152-2.3 BORROW EXCAVATION. MDAD sometimes maintains stockpiles of borrow material at various locations within airport property, and when approved in advance and in writing by MDAD, Project Contractors may use such material from those stockpiles in lieu of importing material from outside the boundaries of the airport property.

Regardless of its source, borrow excavation material shall be tested for possible contamination and analyzed for suitability before use. The Contractor shall notify the Architect/Engineer, at least 30 days prior to beginning the excavation, in order that the necessary tests by the Project Testing Laboratory can be made.

One or a combination of the three following scenarios shall be followed on all projects, as appropriate to the individual project:

a. When MDAD has a supply of borrow material suitable for use by a Project Contractor, the Project Plans will indicate:

(1) The approximate types and quantities of borrow materials available to the Contractor for use;

(2) The approximate location(s) of existing borrow stockpile area(s) within the airport property, which the Contractor may access;

(3) The horizontal and vertical limits from within which the Contractor may obtain material;

(4) The Contractor's allowed route of access between the stockpile areas and the project site.

Borrow excavation material shall be obtained only from the location(s) shown on the Plans or as directed in writing (no oral authorizations allowed) by the Architect/Engineer. The entire process of taking the material from the stockpiles and transferring it to the Project site shall be monitored by MDAD throughout its duration.

b. If borrow stockpile material within the airport boundaries is not available at time of bidding and award but becomes available during construction, then the following conditions shall be met in writing before the material can be used:

(1) All parties shall agree that the borrow material is suitable for the project;

(2) The total amount of material to be used shall be determined and agreed upon;

(3) The Contractor's route of access between the stockpile areas and the project site shall be established and shall be monitored by MDAD throughout the process of transferring material from stockpile to site;

(4) A credit to the Contract for the use of the material shall be negotiated and agreed upon.

Borrow excavation material shall be obtained only from the location(s) shown on the revised Plans, if such are made available, or as directed otherwise in writing by the Architect/Engineer (no oral authorizations allowed). The entire process of taking the material from the stockpiles and transferring it to the Project site shall be monitored by MDAD throughout its duration.

c. If no borrow material stockpile areas, quantities and types are indicated on the Plans, then there is no borrow material available to the Contractor, and borrow material sources outside the boundaries of the airport shall be used. The Contractor shall locate suitable borrow material sources, obtain all necessary permits, purchase, pay for and deliver suitable off-site borrow materials as are required for the Project.

152-2.4 DRAINAGE EXCAVATION. The Contractor shall construct and maintain swales and ditches to the cross section shown on the Plans.

152-2.5 PREPARATION OF EMBANKMENT AREA. Where an embankment is to be constructed to a height of 6 feet *(1.8 m)* or less, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 6 inches *(15 cm)*, and compacted as specified in Article 152-2.6 or otherwise stabilized and/or compacted as shown on the Plans. When the height of fill is greater than 6 feet *(1.8 m)*, topsoil and sod not required to be removed, as shown on the Plans, shall be thoroughly disked and recompacted to the density of the surrounding ground before construction of embankment.

Where embankments are to be placed on natural slopes steeper than 3 to 1, horizontal benches shall be constructed as shown on the plans.

152-2.6 FORMATION OF EMBANKMENTS. Embankments shall be formed in successive layers, parallel to the proposed finished pavement grade line and not more than 8 inches *(20 cm)* in loose average depth (for the full width of the cross section) unless otherwise approved by the Architect/Engineer in writing. The grading operations shall be conducted, and the various soil strata shall be placed and mixed so as to produce a uniform soil structure as shown on the typical cross section. Unsuitable materials and other objectionable materials shall not be incorporated or buried in the embankment. All materials that are incorporated into the embankment shall, in the judgment of the Architect/Engineer, be reasonably free of organic matter such as leaves, grass and coarse roots and it shall not contain more than 6.0% of fine organic matter.

Organic contents shall be determined by the Incineration test performed by the Contractor's Testing Laboratory subject to verification by the Project Testing Laboratory in accordance with AASHTO T-267. The incineration test (performed in accordance with AASHTO T267) shall determine the amount of material lost "on ignition" which amount is the sum total of organic matters and limerock materials and is equal to 100% of the tested materials prior to ignition testing less the residual remaining after ignition testing is completed. Whenever, the incineration test indicates that the amount of materials lost on ignition exceeds 6%, the actual amount of organic matters shall be determined by the Contractor's Testing Laboratory, subject to verification by the Project Testing Laboratory, by further testing the material in accordance with FDOT test Designation FM 5-514 "Test Method for Carbonates and Organic Matter in Limerock" (a copy of FDOT FM 5-514 is incorporated as Appendix I to Section T-611).

Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain or other unsatisfactory conditions of the field. The Contractor shall shape the embankment to provide proper surface drainage for the term of the suspension.

The material in each layer shall be thoroughly watered and shall be at not less than optimum moisture content before compaction or rolling. In order to achieve a uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be performed as appropriate. Should the material be too wet to permit proper compaction or rolling, compaction work on all of the affected portions of the embankment shall be delayed until the material has dried to the required moisture content. Sprinkling of dry material to obtain the proper moisture content shall be done with approved equipment that will sufficiently distribute the water. Sufficient equipment to furnish the required water shall be available at all times. Samples of all embankment materials for testing, both before and after placement and compaction, shall be taken for each 1000 cubic yards of embankment material per layer unless otherwise directed by the Architect/Engineer. Based on the results of these tests, the Contractor shall make the appropriate adjustments in methods, materials or moisture content in order to achieve the specified embankment density.

Under all areas to be paved, including shoulders and areas of blast protection, the embankments shall be compacted full depth to a density of not less than 100 percent of the maximum density as determined by MDAD Technical Specification Section T-611. Under buildings and other structures, the embankment shall be compacted to not less than 98 percent of maximum density as determined by MDAD Technical Specification Section T-611, unless otherwise shown on the Plans. Under all other areas, the embankment shall be compacted to not less than 96 percent of maximum density as determined by MDAD Technical Specification Section T-611, unless otherwise shown on the Plans.

On all areas outside of the pavement or blast protection areas, no compaction will be required on the top 4 inches *(10 cm)*.

The in-place field density shall be determined in accordance with ASTM D 1556 and MDAD Technical Specification Section T-611.

Compaction areas shall be kept separate, and no layer shall be covered by another until the specified density has been obtained as determined by tests.

During construction of the embankment, the Contractor shall route the construction equipment at all times, both when loaded and when empty, over the layers as they are placed and shall distribute the travel evenly over the entire width of the embankment. The equipment shall be operated in such a manner that hardpan, cemented limerock or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.

In the construction of embankments, layer placement shall begin in the deepest portion of the fill; as placement progresses, layers shall be constructed approximately parallel to the proposed finished pavement grade line.

Stones or fragmentary rock larger than 3 inches *(7.5 cm)* in their greatest dimensions shall not be incorporated in the top 12 inches *(30 cm)* of the subgrade. Stones or fragmentary rock larger than 4 inches *(10 cm)* in their greatest dimensions will not be allowed anywhere in the embankment. Rocks or boulders shall be disposed of by the Contractor.

152-2.7 FINISHING AND PROTECTION OF SUBGRADE. After the final layer of subgrade has been substantially completed, the full width of the subgrade shall be conditioned by removing any soft or other unstable material. The resulting areas and all other low areas, holes or depressions shall be brought to grade at the specified density with suitable select material. Where shown on the Plans or specified in the Technical Specifications, the Contractor shall proof-roll the subgrade as specified under Article 152-2.11. The Contractor shall continue to work the subgrade until he has created a thoroughly compacted subgrade shaped to the lines and grades shown on the Plans.

Grading of the subgrade shall be performed so that it will drain readily during construction. The Contractor shall take all precautions necessary to protect the subgrade from damage and shall limit hauling over the finished subgrade to that which is essential for construction purposes.

All ruts or rough places that develop in a completed subgrade shall be smoothed and recompacted.

No subbase, or surface course shall be placed on the subgrade until the subgrade has been tested and approved by the Architect/Engineer for the placement of subsequent construction layers.

152-2.8 HAULING. All hauling shall be considered a necessary and incidental part of the work. Its cost shall be deemed incidental to and included in the Contract Unit Prices included in this Section.

152-2.9 TOLERANCES. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 16-foot *(4.8 m)* straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 1/2-inch *(1.25 cm)*, and shall not be more than 0.05-foot *(1.5 cm)* from the true grade indicated on the Plans. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting by watering and rolling.

On runway safety areas, intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 0.10 foot *(3 cm)* from the true grade shown on the Plans. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152-2.10 STRIPPINGS. Strippings shall consist of salvaged organic soil materials obtained from embankment area stripping or other grading and excavating operations. If, at the time of excavation the stripping material cannot be placed in its proper and final top section of finished construction, the material shall be stockpiled at approved locations shown on the Plans.

If, in the judgment of the Architect/Engineer, it is practical to place the salvaged materials at the time of stripping, the material shall be placed in its final position without stockpiling or further rehandling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed on the shoulders and sideslopes unless directed otherwise in writing by the Architect/Engineer.

152-2.11 PROOF ROLLING. The Contractor shall furnish and operate 50 ton *(45,400 kgs)* pneumatic tired compaction equipment for compacting and testing for uniformity of supporting value and compaction of the subgrade under areas proposed for pavement as shown on the Plans.

The purpose of proof rolling is to determine the location and extent of subgrade areas requiring corrective actions as determined by the Architect/Engineer.

The areas designated for proof rolling shall be prepared and compacted in accordance with the requirements of Article 152-2.7 and shall then be further tested with the 50 ton *(45,400 kgs)* pneumatic tired proof rollers.

The top of the subgrade shall be compacted as specified to the required density and all other pertinent requirements of the specifications prior to proof rolling and the placing of the overlaying courses or lifts. The subgrade shall then be proof rolled such that the specified ground surface is completely traversed by the specified pneumatic tired proof roller. The proof roller shall operate in a systematic manner so that 100% of surface of the subgrade is covered by at least two passes of the proof roller tires, unless otherwise ordered by the Architect/ Engineer.

Within the ranges set forth in the following paragraph on equipment, the load and tire inflation pressure shall be adjusted. It is the intent to use a contact pressure, as nearly as practical, equal to the maximum supporting value of the subgrade. The equipment shall be operated at the appropriate speed to achieve the specified compaction, but in no case shall the speed exceed five (5) miles per hour *(8 km/h)* and the normal operating speed shall not be less than two-and-one-half (2.5) miles per hour *(4 km/h)*.

The proof roller shall be operated briefly to establish the acceptability of the initial stress level. Proof rolling of the subgrade shall be performed at a lower stress level whenever operation of the roller at a higher stress level is accompanied by consistent lateral displacement of soil out of the wheel paths.

Where the operation of the heavy pneumatic tire proof roller shows the subgrade to be unstable, yielding or to have non-uniform supporting value, the Contractor shall remove and replace such material to the depth required to achieve the specified condition, so that supporting value of the subgrade shall be uniform and satisfactory. The moisture content of the material being proof rolled shall be no greater than optimum and no less than three percent (3%) below optimum. The original ground shall then be checked for conformance to the Plan lines and any irregularities of the surface shall be corrected and the original ground shall be shaped to the line and grade reasonably even without grooves, excessive undulation, bumps and it shall not vary more than one-tenth (0.10) of a foot *(3 cm)* from grade.

The proof roller shall consist of a chariot type rigid steel frame with a box body suitable for ballast loading up to fifty (50) tons *(45,400 kgs)* gross weight, and mounted on four (4) pneumatic tired wheels acting in a single line across the width of the roller on its transverse load centerline. The wheels shall be equipped with 18.00 x 24, or 18.00 x 25, 24 ply tires, and shall be suspended on articulated axles such that all wheels carry approximately equal loads when operating over uneven surfaces.

The gross ballasted weight and tire inflation pressure of the proof roller shall be adjusted as required to achieve the specified condition, subject to approval by the Architect/Engineer.

METHOD OF MEASUREMENT

152-3.1 Measurement of On-Site Excavation, including any unsuitable subsoil, for payment shall be the number of cubic (yards) *(meters)* of material excavated as measured in its original position, complete and accepted as shown on the Plans.

Measurement of On-Site Excavation, shall be computed by the average end area method. The end area is that area bound by the original ground line established by cross sections and the final theoretical pay limit lines as shown on the Plans. The quantities of strippings shall be included in the measurement of On-Site Excavation for payment.

Measurement of On-Site Excavation, shall not include any quantities of materials excavated or placed beyond pay limit lines shown on the Plans.

152-3.2 Measurement of Off-Site Borrow for Payment shall be the number of (tons) *(1,000 kgs)* of Off-Site Borrow material delivered and placed complete and accepted as shown on the Plans. Measurement of Off-Site Borrow shall be computed from truck weight delivery tickets obtained from a scale certified in accordance with State of Florida requirements.

152-3.3 Measurement of On-Site Borrow for Payment shall be the number of cubic (yards) *(meters)* of On-Site Borrow material excavated from County furnished stockpiles (located within the Airport site), delivered and placed complete and accepted as shown on the Plans.

Measurement of On-Site Borrow shall be computed by the average end areas method. The end area is that area bound by the original stock pile ground line established by cross sections and the final lines after all on-site borrow excavation is completed. The quantities of strippings, if any is required, shall not be included in the measurement of On-Site Borrow for payment.

152-3.4 Measurement of Proof Rolling for Payment shall be the number of 1,000 square (yards) *(meters)* of measure of subgrade actually proof rolled and accepted in accordance with the Plans and Specifications.

BASIS OF PAYMENT

152-4.1 Payment for the quantities measured as described in Article 3 above shall be made at the Contract Unit Price Bid per cubic yard, for On-Site Excavation, per ton for Off-Site Borrow, per cubic yard for On-Site Borrow, and per 1,000 square yards for Proof Rolling, which prices and payments shall be full compensation for furnishing all labor, materials, equipment, processes, tools, and incidentals necessary to complete the work under this Section.

Payment will be made under:

Item No.	On-Site Excavation -- per cubic (yard) *(meter)*
Item No.	Off-Site Borrow -- per (ton) *(1,000 kgs)*
Item No.	On-Site Borrow -- per cubic (yard) *(meter)*
Item No.	Proof Rolling -- per 1,000 square (yards) *(meters)*

152-5 TESTING AND MATERIAL REQUIREMENTS

Section MDAD P-160	Contaminated Soil/Groundwater
Section MDAD T-611	MDAD Compaction Control and Limerock Testing
ASTM D1556	Test for Density of Soil In-Place by the Sand Cone Method
AASHTO T-267	Determination of Organic Contents in Soils by Loss on Ignition

END OF SECTION

Item P-153 Controlled Low-Strength Material (CLSM)

DESCRIPTION

153-1.1 This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches or at other locations shown on the plans or as directed by the Engineer

When approved by the Engineer, the Contractor may use CLSM to replace backfill material.

MATERIALS

153-2.1 Materials.

a. Cement. Cement shall conform to the requirements of ASTM 150 Type II or ASTM C595 - Type IL.

b. Fly ash. Fly ash shall conform to ASTM C618, Class C or F.

c. Fine aggregate (sand). Fine aggregate shall conform to the requirements of ASTM C33 except for aggregate gradation. Any aggregate gradation which produces the specified performance characteristics of the CLSM and meets the following requirements, will be accepted.

Sieve Size	Percent Passing by weight
3/4 inch (19.0 mm)	100
No. 200 (75 µm)	0 - 12

d. Water. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

MIX DESIGN

153-3.1 Proportions. The Contractor shall submit, to the RPR, a mix design including the proportions and source of aggregate, fly ash, cement, water, and approved admixtures. No CLSM mixture shall be produced for payment until the RPR has given written approval of the proportions. The proportions shall be prepared by a laboratory and shall remain in effect for the duration of the project. The proportions shall establish a single percentage or weight for aggregate, fly ash, cement, water, and any admixtures proposed. Laboratory costs are incidental to this item.

a. Compressive strength. CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi (690 to 1379 kPa) when tested in accordance with ASTM D4832, with no significant strength gain after 28 days.

b. Consistency. Design CLSM to achieve a consistency that will produce an approximate 8-inch (200 mm) diameter circular-type spread without segregation. CLSM consistency shall be determined per ASTM D6103.

CONSTRUCTION METHODS

153-4.1 Placement.

a. Placement. CLSM may be placed by any reasonable means from the mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed so structures or pipes are not displaced from their final position and intrusion of CLSM into unwanted areas is avoided. The material shall be brought up uniformly to the fill line shown on the plans or as directed by the RPR. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one lift, the base lift shall be free of surface water and loose foreign material prior to placement of the next lift.

b. Contractor Quality Control. The Contractor shall collect all batch tickets to verify the CLSM delivered to the project conforms to the mix design. The Contractor shall verify daily that the CLSM is consistent with 153-3.1a and 153-3.1b. Adjustments shall be made as necessary to the proportions and materials as needed. The Contractor shall provide all batch tickets to the RPR.

c. Limitations of placement. CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35°F (2°C) and rising. Mixing and placement shall stop when the air temperature is 40°F (4°C) and falling or when the anticipated air or ground temperature will be 35°F (2°C) or less in the 24-hour period following proposed placement. At the time of placement, CLSM shall have a temperature of at least 40°F (4°C).

153-4.2 Curing and protection

a. Curing. The air in contact with the CLSM shall be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32°F (0°C), the material may be rejected by the RPR if damage to the material is observed.

b. Protection. The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi (105 kPa) is obtained. The Contractor shall be responsible for providing evidence to the RPR that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 153-3.1a.

153-4.3 Quality Assurance (QA) Acceptance. CLSM QA acceptance shall be based upon batch tickets provided by the Contractor to the RPR to confirm that the delivered material conforms to the mix design.

METHOD OF MEASUREMENT

153-5.1 Measurement.

No separate measurement for payment shall be made for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

BASIS OF PAYMENT

153-6.1 Payment.

No payment will be made separately or directly for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low-Strength Material (CLSM) Test Cylinders
ASTM D6103	Flow Consistency of Controlled Low Strength Material (CLSM)

END OF ITEM P-153

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Item P-154S Stabilized Subgrade
SUPPLEMENT

The work to be performed under the classification of Subbase Course (Stabilized Subgrade) shall meet the requirements of Section P-154 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

REPLACE the title of this Section to:

SECTION P-154 STABILIZED SUBGRADE

DELETE in Section P-154 the term “Subbase” and **INSERT** “Stabilized Subgrade”

DESCRIPTION

MATERIALS

DELETE Article 154-2 number and **INSERT** 154-2.1

Add to article 154-2.1 the requirement below

The stabilized subgrade shall exhibit a soaked California Bearing Ratio (CBR) value of at least 45 when tested in accordance with ASTM D1883 at 100% of ASTM D1557 maximum density or a minimum soaked Lime Rock Bearing Ratio (LBR) of 56 when tested in accordance with Florida Test Method FM-5-515 at 100% of ASTM D1557 maximum density.

Add article 154-2a **SAMPLING AND TESTING**

154-2.a Sampling and testing. Samples shall be taken by the Contractor per ASTM D75 for initial material requirements. . The Contractor shall submit to the Resident Project Representative (RPR) certified test results showing that the lime rock meets the Material requirements of this section. Tests shall be representative of the material to be used for the project.

CONSTRUCTION METHODS

DELETE article 154-3.1 in its entirety and **INSERT**:

154-3.1 General. Prior to the beginning of stabilizing operations, construct the area to be stabilized to an elevation such that, upon completion of grading operations, the completed stabilized subgrade will conform to the lines, grades, and cross-sections shown on the plans. Prior to spreading lime rock, bring the surface of the existing soils to a surface approximately parallel to the surface of the proposed finished grade.

DELETE article 154-3.2 in its entirety and **INSERT**:

154-3.2 Control Strip. The first half-day of stabilized subgrade construction shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The compacted thickness shall be 12 inches upon the Contractor’s demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production. Where lime rock is mixed with existing soil, the Contractor shall excavate two (2) trenches in the control strip to demonstrate the lime rock has been thoroughly and uniformly mixed with the existing soil. Backfill the trenches with the excavated material and compact in accordance with this specification.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR

ADD to article 154-3.3 the following paragraph:

The Contractor shall provide an approved lightweight 12 foot (3.7 m) straightedge of aluminum construction for use by the Engineer in testing the finished surface.

DELETE article 154-3.4 in its entirety and **INSERT**:

154-3.4 Preparing underlying subgrade. After completing the grading operations, samples of existing soils from within the depth of the stabilized subgrade shown on the plans shall be obtained in accordance with ASTM D75. Obtain a minimum of two samples per phase randomly sampled in accordance with ASTM D3665 and additional samples when a visible change in soil is observed. For each sample, determine the quantity (if any) of lime rock necessary for compliance with the bearing value requirements of paragraph 154-2.1. Determine the optimum moisture content and maximum dry density of each sample in accordance with ASTM D1557. The Contractor shall provide a subgrade stabilization plan a minimum of 7 days prior to commencing subgrade stabilization; the plan shall include the following:

- Sampling locations and soil classification in accordance with ASTM D2487.
- Results of bearing value testing of each sample in accordance with paragraph 154-2.1.
- Moisture-density relationship of each sample in accordance with ASTM D1557.
- Proposed limits of stabilization and required amount of lime rock (if any).
- List of equipment.

Prior to applying the lime rock, clean the exposed surface of all foreign substances.
Where demolition of the existing pavement results in a subgrade elevation below that shown on the plans, lime rock shall be used to make up the grade difference by mixing it into the stabilized subgrade, regardless if it is necessary for compliance with the bearing value in paragraph 154-2.1. The lime rock is incidental and will not be paid separately.

ADD to article 154-3.5 the following paragraph:

The stabilized subgrade shall be accepted for density and thickness on an area basis. One test shall be made for density and thickness for each 500 square yards. Sampling locations will be determined on a random basis per ASTM D3665.

DELETE article 154-3.9 in its entirety and **INSERT**:

154-3.9 Surface tolerance. The surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

a. Smoothness. The finished surface shall not vary more than +/- ½ inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

b. Grade. The grade and crown shall be measured on the grid shown on the pavement elevation plans and shall be within +/-0.05 feet of the specified grade.

Add to article 154-3.10 the following Language:

The Contractor shall replace, at their expense, stabilized subgrade where depth tests have been taken.

Add to article 154-3.12 the following Language:

No base course shall be placed on the stabilized subgrade until the stabilized subgrade has been accepted by the RPR.

Add article 154-3.13 PROOF ROLLING

154-3.13 Proof rolling. The purpose of proof rolling the stabilized subgrade is to identify any weak areas in the stabilized subgrade and not for compaction of the stabilized subgrade. After compaction is completed, the stabilized subgrade area shall be proof rolled with a 20 ton Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to 100 psi in the presence of the RPR. Apply a minimum of 4 coverages, or as specified by the RPR, to all areas receiving stabilized subgrade. A coverage is defined as the application of one tire print over the designated area. Soft areas of stabilized subgrade that deflect more than 1 inch or show permanent deformation greater than 1 inch shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

The Contractor's quality control laboratory shall provide a signed report documenting the proof rolling process (including representative photographs), observed deflections/deformations, and any limits of rework or removal and replacement.

Add article 154-3.14 WEATHER LIMITATION

154-3.14 Weather limitation. Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on stabilized subgrade shall not be conducted when the subgrade is wet.

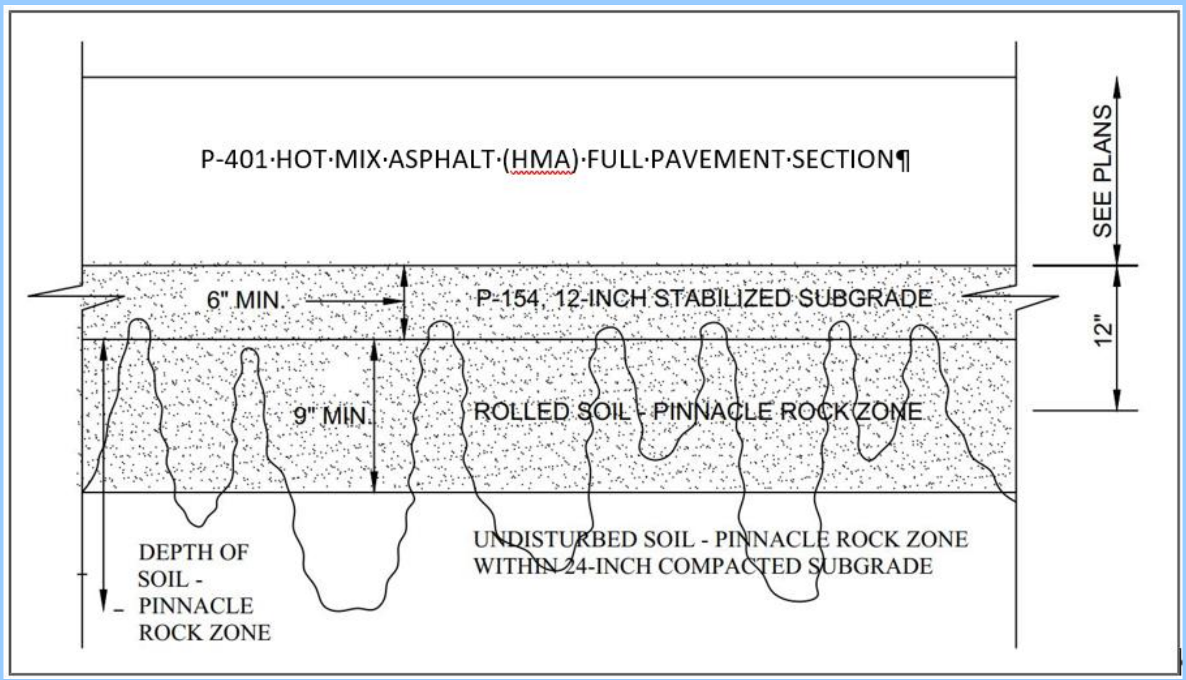
Add article 154-3.15 PINNACLE ROCK TREATMENT

154-3.15 Pinnacle Rock Treatment. The Miami Limestone forms the bedrock in the Miami area, which includes the Miami International Airport. The Miami Limestone has been affected by karst dissolution resulting in the pinnacle surface observed at previous construction sites at the airport. The voids between the pinnacle rock is filled with loose sand and soil. Evidence of this Pinnacle Rock condition was not detected during the Geotechnical Subsurface Exploration completed for this project. Nevertheless, the Contractor shall consider in the bid price for associated Pay Items the treatment of the Pinnacle Rock if this subsurface condition is encountered during the construction process.

Location of the Pinnacle Rock Condition:

1. Flexible Pavement Section, Pinnacle Rock **Below** Stabilized Subgrade. Refer to Section P-152 for treatment.
2. Flexible Pavement Section, Pinnacle Rock **In** Stabilized Subgrade. Refer to treatment details below.

Typical Section - Pinnacle Rock Condition In Stabilized Subgrade



Pinnacle Rock Treatment:

1- Scarify and blend thoroughly to a depth of at least 9 inches below top of rock formation and compact the soil - rock zone using 35 to 50 ton roller at Engineer's direction. Density tests not required within soil - rock zone.
2- Build up at least a 6 inches layer of the P-154, 12-inch Stabilized Subgrade below the bottom of the Base Course (P-211).
3- Proof roll the soil - rock zone using 35 to 50 ton roller at Engineer's direction after placing and compacting the first 6" layer of the Stabilized Subgrade
4- Complete remaining P-154, 12-inch Stabilized Subgrade rade to bottom of Base Course (P-211).
5- Construct Base Course (P-211) and balance of the pavement section shown in the plans.

METHOD OF MEASUREMENT

DELETE Article 154-4.1 and 154-4.2 in its entirety and **INSERT** the following

154-4.1 The quantity of 12" stabilized subgrade shall be measured by the number of square yards of stabilized subgrade placed and compacted to specified density and plan thickness requirements in the completed course. The quantity of stabilized subgrade shall be measured in its final position and as accepted by the RPR.

154-4.2 The quantity of 18” stabilized subgrade shall be measured by the number of square yards of stabilized subgrade placed and compacted to specified density and plan thickness requirements in the completed course. The quantity of stabilized subgrade shall be measured in its final position and as accepted by the RPR.

BASIS OF PAYMENT

DELETE article 154-5.1 in its entirety and **INSERT** the following:

154-5.1 Payment shall be made at the contract unit price per square yard for 12” stabilized subgrade. This price shall be full compensation for furnishing all materials (including lime rock); for all preparation, hauling, placing, mixing, grading, moisture-conditioning, compaction, proof rolling, and testing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

154-5.2 Payment shall be made at the contract unit price per square yard for 18” stabilized subgrade. This price shall be full compensation for furnishing all materials (including lime rock); for all preparation, hauling, placing, mixing, grading, moisture-conditioning, compaction, proof rolling, and testing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-154-5.1	12” Stabilized Subgrade - per square yard
Item P-154-5.2	18” Stabilized Subgrade - per square yard

INSERT the references (publications) below to the **MATERIALS AND TESTING REQUIREMENTS** Section

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-154

SECTION P-154 SUBBASE COURSE

DESCRIPTION

154-1.1 The work under this Section consists of the construction of a 3 inch *(75 mm)* work platform composed of granular limerock materials and/or a stabilized subgrade course composed of granular materials and insitu soils, constructed on a prepared existing soil stratum or on top of placed soil embankment, in accordance with the Plans and Specifications.

154-1.2 RESPONSIBILITY. The Contractor shall be solely responsible for all work performed and quality control procedures performed under this Item.

The County will retain the services of a Professional Testing Laboratory referred to herein as the "Project Testing Laboratory," to perform independent testing to verify the Contractor's quality control performance. The Project Testing Laboratory will perform testing at the direction of the Architect/Engineer and the Project Testing Laboratory will perform all acceptance tests. The county will pay for all testing performed by its Project Testing Laboratory.

MATERIALS

154-2 The limerock work platform material shall consist of well graded fossiliferous limestone of uniform quality. The rock shall show no tendency to "air slack" or undergo chemical change when exposed to the weather. The material when watered and rolled shall be capable of being compacted into a dense and well-bonded course.

The limerock used in the construction of the work platform shall be newly mined, crushed and graded Miami Oolitic Limerock meeting the following requirements:

Carbonates of calcium and magnesium - not less than 70%.

Oxides of iron and aluminum - not more than 2%.

The combined amount of carbonates, oxides, and silica shall be at least 97%.

The material shall be non-plastic, determined in accordance with ASTM D4318 and as modified in DCAD T-611.

The chemical analysis of the new limerock shall consist of determining the silica insoluble, iron oxide, and alumina by solution of the sample in hydrochloric (HC1) acid, evaporating, dehydrating, redissolving the residue, and neutralizing with ammonium hydroxide, filtering, washing and igniting the residue limerock. The difference between this insoluble matter and 100% is classified as carbonates of calcium and magnesium and organic matters.

The new limerock shall not contain more than 1.0% of organic materials such as roots, leaf mold, organic, or foreign matter and shall be obtained from pits from which all overburden has been removed previous to blasting and quarrying. Organic content shall be determined in accordance with FDOT test Designation FM 5-514 "Test Method for Carbonates and Organic Matter in Limerock" (a copy of FDOT FM 5-514 is incorporated as Appendix I to Section T-611.

The gradation of the limerock shall meet the following requirements:

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
3 inch *(75 mm)*	100
3/4 inch *(19 mm)*	50-100

All material shall be graded uniformly down to dust.

All fine material shall consist entirely of dust of fracture.

The work platform may also be constructed of clean non-plastic limerock materials, salvaged from work under this contract or from other DCAD projects.

The stabilized subgrade course shall be constructed of either newly mined limerock material or of salvaged non-plastic limerock materials mixed with existing natural insitu granular and/or limerock material.

Salvaged limerock used in the work platform shall meet the chemical and organic requirements specified above for new limerock and its use shall be subject to approval by the Architect/Engineer.

The portion of the limerock material passing the No. 40 sieve *(0.45 mm)* shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with ASTM D4318 as modified in DCAD T-611.

CONSTRUCTION METHODS

154-3.1 GENERAL. The 3" *(75 mm)* limerock work platform shall be placed selectively to achieve an even bearing value throughout the area designated on the Plans, or as directed by the Architect/Engineer. The materials shall be shaped and thoroughly compacted as specified in Article 154-3.8. No compaction requirements are specified for the work platform, however compaction requirements must be obtained on layers immediately above or below this work platform as shown on the Plans.

The stabilized subgrade course shall be constructed to the depth shown on the Plans, or as directed by the Architect/Engineer. The materials shall be placed, mixed, shaped and compacted using the methods and procedures specified in this Section. Compaction tests shall be performed on this stabilized soil layer as specified in this Section and as shown on the Plans.

154-3.2 OPERATION IN PITS. All work involved in clearing and stripping pits and handling unsuitable material encountered shall be performed by the Contractor at his expense. The limerock material shall be obtained from FDOT approved pits or sources, subject to approval by the Architect/ Engineer. The material in the pits shall be excavated and handled in such manner that a uniform and satisfactory product is secured.

154-3.3 EQUIPMENT. All equipment necessary for the proper construction of the work shall be of the proper design and capacity to perform the intended work, shall be in first-class working condition, and shall have been approved by the Architect/Engineer before construction is allowed to start.

The Contractor shall provide an approved lightweight 16 foot *(4.8 m)* straightedge of aluminum construction for use by the Architect/Engineer in testing the finished surface.

154-3.4 PREPARING UNDERLYING COURSE. Before any stabilizing material is placed, the Contractor shall prepare and condition the underlying course as specified. The underlying course shall be checked and accepted by the Architect/Engineer before placing and spreading operations are started.

Grade control between the edges of the pavement shall be accomplished using grade stakes, steel pins, or forms placed in lines parallel to the centerline of the pavement and at intervals which will permit string lines or check boards to be placed between the stakes, pins, or forms.

To protect the subgrade and to ensure proper drainage, the spreading and/or mixing of the stabilizing material shall begin along the centerline of the pavement on a crowned section or on the high side of pavements with a one-way slope.

154-3.5 MATERIALS ACCEPTANCE IN EXISTING CONDITION. When the subbase material is obtained in a uniform and satisfactory condition and it contains approximately the required moisture, such material may, with the approval of the Architect/Engineer, be moved directly to the spreading equipment for placing. The material shall be approved material meeting the requirements of Article 154-2.1, and it may be obtained from off-site rock pits, select salvaged onsite limerock materials, on-site stockpiles, or it may be produced from a crushing, screening and blending plant. The moisture content of the material shall be approximately that required to obtain maximum density. Any minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances, mixing or manipulation may be required, immediately preceding the rolling, to obtain the required moisture content. The completed surface shall be bladed or dragged, if necessary, to obtain a smooth uniform surface true to line and grade.

154-3.6 MIXED IN PLACE. When materials from different sources are to be proportioned and mixed or blended in place, the relative proportions of the components of the mixture shall be as determined by the Contractor and approved by the Architect/Engineer prior to commencing work under this Section.

The stabilizing material shall be deposited and spread evenly to a uniform thickness and width.

The required amount of materials shall be placed, and thoroughly mixed and blended by means of graders, discs, harrows, rotary tillers, supplemented by other suitable equipment if necessary. The mixing shall continue until the mixture is uniform throughout. Areas of segregated material shall be corrected by the addition of material if required. Water shall be uniformly applied prior to and during the mixing operations, if necessary, to maintain the material at its required moisture content. When the mixing and blending has been completed, the material shall be spread in a uniform layer which, when compacted, will meet the requirements of thickness, bearing value and typical cross section.

154-3.7 GENERAL METHODS FOR PLACING. The subbase courses shall be constructed in layers of not less than 3 inches *(75 mm)* nor greater than 6 inches *(150 mm)* in compacted thickness. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. The subbase material, unless otherwise permitted by the Architect/Engineer, shall not be spread more than 2,000 square yards *(1800 square meters)* in advance of the rolling. No material shall be placed in rain or on a soft, muddy, or disturbed course.

The Contractor shall prevent the incorporation of foreign material into the subbase course mixture.

154-3.8 FINISHING AND COMPACTING. After spreading or mixing, the subbase material shall be thoroughly compacted by rolling and sprinkling, as necessary. Sufficient rollers shall be furnished to adequately handle the rate of placing, mixing and spreading of the subbase course.

Rolling shall progress gradually from the center of the lane under construction, or from one side toward previously placed material, by lapping uniformly each preceding track by at least 12 inches *(30 cm)*. Rolling of the limerock work platform shall continue until the material is thoroughly set and stable. Rolling of the stabilized subgrade material shall continue until the materials are thoroughly set and stable, and the subbase course and the subgrade soil below has been compacted to not less than 100% of maximum density at optimum moisture and tested as required by this Section, as shown on the Plans, and as specified in Section DCAD T-611.

The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the subbase course. When the rolling develops irregularities that exceed 1/2 inch *(12.5 mm)* when tested with a 16-foot *(4.8 m)* straightedge, the irregular surface shall be loosened and then refilled with the same kind of material as that used in constructing the course and again rolled as required above.

In those places inaccessible to rollers, the subbase material may be tamped thoroughly with mechanical or hand tampers, provided that specified densities are obtained.

Sprinkling during rolling, if necessary, shall be in the amount and by equipment approved by the Architect/Engineer. Water shall not be added in such a manner or quantity to cause the underlying layer to become soft or yielding.

Immediately following the final compaction and density testing of the stabilized subgrade course and while the material is still at or near optimum moisture, Field In-Place California Bearing Ratio (CBR) Tests shall be performed, in accordance with the requirements of DCAD Section T-611. CBR values shall be not less than the values shown on the Plans.

154-3.9 SURFACE TEST. After the course is completely compacted, the surface shall be tested for accuracy of grade and crown; any portion found to fail in accuracy of grade or crown shall be scarified, reshaped, recompacted, and otherwise manipulated as the Architect/Engineer may direct until the required accuracy is obtained. The finished surface shall not vary more than 1/2 inch *(12.5 mm)* when tested with an approved 16-foot *(4.8 m)* straightedge applied parallel with, and at right angles to, the centerline.

154-3.10 THICKNESS. The thickness of the completed subbase course shall be determined by depth tests taken at intervals so each test represents no more than 500 square yards *(450 square meters)*, or as otherwise directed by the Architect/Engineer. The depth tests shall be made by test holes, at least 3 inches *(75 mm)* in diameter through the subbase. When the deficiency in thickness is more than 1/2 inch *(12.5 mm)*, and correction by adding material will exceed subbase finished elevation, the Contractor shall correct such areas by removing subbase materials, correcting the subgrade and reconstructing the base. Correction work not exceeding allowable subbase finished elevation may be made by scarifying, adding satisfactory mixture, rolling, sprinkling, reshaping, and finishing in accordance with these specifications. The Contractor shall replace the subbase material where borings are taken for test purposes. The thickness of the subbase in the affected area shall be remeasured by depth tests or elevations.

154-3.11 PROTECTION. Work on subbase course shall not be conducted when the subgrade is wet or is otherwise unsatisfactory. No traffic of any kind, including construction traffic, will be permitted on the completed subbase course except equipment employed in the construction of the next course.

154-3.12 MAINTENANCE. Following the final shaping of the material, the subbase shall be maintained throughout its entire area, until the Contractor starts construction of the next course.

METHOD OF MEASUREMENT

154-4.1 Measurement of work platform (3") *(75 mm)* for payment shall be the number of square (yards) *(meters)* actually constructed and accepted in accordance with the Plans and Specifications.

154-4.2 Measurement of stabilized Subgrade (__") *(____ cm)* for payment shall be the number of square (yards) *(meters)* of each thickness actually constructed and accepted in accordance with the Plans and Specifications.

BASIS OF PAYMENT

154-5.1 Payment for the quantities of Work Platform (3") *(75 mm)* and Stabilized Subgrade (__") *(___ cm)* measured as described above shall be made at the Contract Unit Prices Bid per square (yard) *(meter)*, which prices and payment shall be full compensation for furnishing all materials, labor, equipment, processes, tools, and incidentals necessary to complete the work under this Section.

Payment will be made under:

Item No.	Work Platform (3") *(75 mm)*	Per Square (Yard) *(Meter)*
Item No.	Stabilized Subgrade (____")*(___ cm)* thickness	Per Square (Yard) *(Meter)*

MATERIALS AND TESTING REQUIREMENTS

ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AASHTO T-180 Moisture Density Relations of Soils using 10 lb *(4.54 kg)*. Rammer and an 18 inch *(457 mm)* Drop.

DCAD T-611 DCAD Compaction Control Tests

Asphalt Institute Manual Series No. 10 - Field CBR
(April 1963 Edition)

END OF SECTION

SECTION P-160S
CONTAMINATED SOIL / GROUDWATER
SUPPLEMENT

The work to be performed under the classification of **Contaminated Soil / Groundwater** shall meet the requirements of Section P-160 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

CONSTRUCTION METHODS

MEASUREMENT AND PAYMENT

DELETE article 160-4.7 DEWATERING/TREATMENT OF CONTAMINATED GROUDWATER in its entirety and **INSERT**

No separate payment shall be made for Dewatering/Treatment of contaminated Groundwater.

INSERT the summary pay Item below at the end of the Section.

Payment will be made under:

Item No. P-160-1	Temporary Stockpiling of Suspected and ENR Soil without berm/lining - per CY
Item No. P-160-2	Temporary Stockpiling of Suspected and ENR Soil with berm/lining - per CY
Item No. P-160-3	Transportation/Disposal of Non-Hazardous Soil - per ton (TN)
Item No. P-160-4	Transportation/Incineration of Soil - per ton (TN)
Item No. P-160-5	Transportation/Disposal of Hazardous Soil - per ton (TN)
Item No. P-160-6	Removal/Disposal of FFHP - priced per gallon (GAL)
Item No. P-160-7	Skimming/Transportation/Disposal of Absorbent Pads/Booms priced per each (EA)

END OF SECTION

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SECTION P-160 CONTAMINATED SOIL / GROUNDWATER

DESCRIPTION

160-1.1 GENERAL. The purpose of this section is to provide basic guidelines for properly working (i.e., excavation, handling, transportation, disposal, etc.) with contaminated soil/groundwater during construction and/or any other activities that require the excavation of soil and/or exposure of groundwater, to prevent negative environmental impacts such as cross contamination, spreading out existing contamination that is already contained, etc. All excavation shall be conducted in accordance with the contract and construction documents, MDAD Standard Technical Specification Section P-152. However, it shall be understood that in no way are these guidelines intended to supersede existing environmental laws and regulations. The contractors and all subcontractors shall comply with all applicable federal, state and local environmental laws and regulations including but not limited to US Environmental Protection Agency (EPA), Florida Department of Environmental Protection (FDEP), South Florida Water Management District (SFWMD) and Miami-Dade County Department of Environmental Resources Management (DERM).

160-1.2 CLASSIFICATIONS. For the purpose of these specifications the following classifications are used:

a. Clean Fill Soils: These soils meet the DERM defined clean fill criteria and can be reused anywhere on or off airport property without restrictions.

b. Residential Soils: These soils meet the DERM defined residential criteria and upon DERM approval can be reused within the airport without tracking requirements.

c. Industrial Soils: These soils meet the DERM defined industrial criteria and upon DERM approval can be reused within the airport. These soils require tracking from origin to final disposition.

d. Environmentally Non-Reusable Soils (ENR): These soils exceed the DERM defined industrial or the Federal hazardous levels and cannot be reused on site. These soils require proper disposal offsite.

e. Suspect Soils: Soils from any area pre-designated by DERM or MDAD as an area where the requirements of this Standard Technical Specification Section P-160 shall be implemented, pursuant to the results of the pre-construction assessment or designated during field activities by MDAD or its designated representatives.

HEALTH AND SAFETY

160-2.1 HEALTH AND SAFETY. The contractors and all subcontractors working with contaminated soil/groundwater shall conform to all applicable laws, regulations and guidelines such as, but not limited to, EPA Hazardous Waste Operations and Emergency Response (HAZWOPER), US Occupational Safety and Health Agency (OSHA) and National Institute of Occupational Safety and Health (NIOSH).

CONSTRUCTION METHODS

160-3.1 CONTAMINATED SOIL / GROUNDWATER DETECTION. If contaminated groundwater, visible stains in the soil, free floating product, sheen on groundwater, or odor in soil/groundwater are detected during the normal course of construction activities, the Contractor shall immediately:

a. Notify the Architect/Engineer (A/E).

b. Notify the Miami-Dade Aviation Department, Environmental Engineering Division (MDAD-EE) at (305) 876-7928 or (305) 869-1063.

c. Notify DERM at (305) 372-6789.

d. Proceed with the work in accordance to the contract and construction documents and the provisions of these guidelines. To avoid miscommunication, any directives from MDAD and/or DERM shall be given through the A/E to the Contractor.

160-3.2 STOCKPILING OF SUSPECTED AND ENR SOIL. Prior to the excavation of suspected and ENR soil, the Contractor shall prepare a suitable area previously approved by the A/E for stockpiling such soil in accordance with the contract and construction documents. The Contractor shall take due care during the stockpiling operation to prevent the spread of any further contamination. The stockpile shall not exceed twelve (12) feet in height. The Contractor shall regularly inspect the stockpile area and restore its protection membranes to their original required condition and maintain them throughout the entire construction contract period.

After the Contractor has safely completed the stockpiling, the MDAD-EE shall collect soil samples (by volume) from the stockpile and send the samples to a certified laboratory to be analyzed for applicable environmental criteria. Once a stockpile has been sampled, it cannot be altered in any way. Therefore, the MDAD-EE shall mark the stockpile with a yellow flag, indicating that the final disposition of the stockpile is pending the analytical results from the laboratory. Once the analytical results are available, DERM shall determine the final disposition of the soil. If according to the analytical results, DERM determines that the soil can be reused on site, MDAD-EE shall remove the yellow flag and replace it with a green flag, indicating that the stockpile has been approved for reuse on site. If according to the analytical results, DERM determines that the soil cannot be reused and therefore it must be properly disposed of, MDAD-EE shall remove the yellow flag and replace it with a red flag, indicating that the stockpile cannot be reused. Unless otherwise specified by the A/E, the Contractor shall handle, transport and properly dispose of all ENR soils.

Prior to the excavation of suspected soil, the Contractor shall prepare a suitable area (previously approved by the A/E) for stockpiling soil on an impervious surface, away from any drainage and/or active utility structures. If an impervious surface is not available, the Contractor shall create it by laying down two (2) layers of polyethylene film (each a minimum of four (4) mils thick) on a flat horizontal surface with a twelve (12) inch high berm around its perimeter. The stockpile area shall be free of any sharp materials and debris that could accidentally puncture the polyethylene film. The area selected for stockpiling must be free from water ponding. Once the stockpile is completed, a single layer of the same polyethylene film material shall be placed over the stockpile and secured properly. Rainwater must be directed outside the berm-contained area. Any rainwater collected inside the berm-contained area, must be collected, stored and treated as directed by the A/E. Continued inspection of the stockpile area is required to ensure the polyethylene film is intact and secure and to maintain proper drainage and drainage collection as stated herein.

160-3.3 TRANSPORTATION / HAULING OF SOIL. The Contractor shall transport the ENR soil in accordance with all applicable laws and regulations. Haulers shall be certified to transport the soil as classified.

160-3.4 DISPOSAL OF NON-HAZARDOUS SOIL AT LANDFILL. If the soil is to be disposed of in a landfill, the Contractor shall dispose of all non-hazardous soils in an approved landfill licensed to handle the soil as classified. The Contractor shall conduct disposal activities in accordance with all applicable laws and regulations.

160-3.5 INCINERATION OF SOIL. If the soil is to be incinerated, the Contractor shall transport the soil to a certified incineration facility licensed to handle the soil as classified. The Contractor shall conduct the transportation and handling activities in accordance with all applicable laws and regulations.

160-3.6 DISPOSAL OF HAZARDOUS SOIL. If soil is classified as hazardous, the Contractor shall prepare, transport and dispose of the soil in accordance with all applicable laws and regulations such as, but not limited to, the Code of Federal Regulations (CFR), EPA, FDEP, DERM, etc., at a licensed hazardous material disposal facility.

160-3.7 REMOVAL / DISPOSAL OF FREE-FLOATING HYDROCARBON PRODUCT (FFHP). The Contractor shall remove/dispose of FFHP and/or sheen in accordance with all applicable laws and regulations.

160-3.8 TRANSPORTATION / DISPOSAL MANIFESTS. The Contractor shall provide copies of all the manifests for the proper transportation/disposal of contaminated soil and/or free-floating product to the A/E and the MDAD-EE.

160-3.9 DEWATERING / TREATMENT OF CONTAMINATED DEWATERING GROUNDWATER. MDAD-EE encourages, whenever possible, that construction activities be carried out in the wet. If dewatering in areas of groundwater contamination is absolutely necessary for construction purposes, the Contractor shall apply for and obtain the dewatering permit(s) from the appropriate regulatory agencies. Once the permit(s) has(have) been obtained, the Contractor shall comply with all the permit conditions during the entire course of the dewatering activities. If the permit(s) expire(s) before the dewatering activities are completed, the Contractor shall obtain a permit renewal within the stipulated time frame. The Monthly Pumpage Report required by the dewatering permit shall be submitted to the MDAD-EE no later than the 5^{th} day of the following month.

MEASUREMENT AND PAYMENT

160-4.1 EXCAVATION. All excavation shall be paid pursuant to MDAD Standard Technical Specification Section P-152.

160-4.2 TEMPORARY STOCKPILING OF SUSPECTED AND ENR SOIL. Measurement and payment shall be at the Contract Unit Price per cubic yard (CY) measured in place at the stockpile for labor, materials, equipment, stockpiling, and all other work necessary to properly handle and stockpile suspected soil.

Payment will be made under:

Item No. Temporary Stockpiling of Suspected and ENR Soil without berming/lining - per CY

Item No. Temporary Stockpiling of Suspected and ENR Soil with berming/lining - per CY

160-4.3 TRANSPORTATION/DISPOSAL OF NON-HAZARDOUS SOIL AT A LANDFILL. Measurement and payment shall be at the Contract Unit Price per ton as measured by a certified scale for labor, materials, equipment, loading, hauling and disposal costs, and all other work necessary to transport and dispose of non-hazardous soil.

Payment will be made under:

Item No. Transportation/Disposal of Non-Hazardous Soil - per ton

160-4.4 TRANSPORTATION/INCINERATION OF SOIL. Measurement and payment shall be at the Contract Unit Price per ton as measured by a certified scale for labor, materials, equipment, loading, hauling and disposal costs, and all other work necessary to transport and dispose of contaminated soil via incineration.

Payment will be made under:

Item No. Transportation/Incineration of Soil - per ton

160-4.5 TRANSPORTATION/DISPOSAL OF HAZARDOUS SOIL AT AN APPROVED HAZARDOUS WASTE DISPOSAL FACILITY. Measurement and payment shall be at the Contract Unit Price per ton as measured by a certified scale for labor, materials, equipment, loading, hauling and disposal costs, and all other work necessary to transport and dispose of hazardous soil at an approved hazardous waste disposal facility.

Payment will be made under:

Item No. Transportation/Disposal of Hazardous Soil - per ton

160-4.6 REMOVAL/DISPOSAL OF FREE FLOATING HYDROCARBON PRODUCT. Measurement and payment shall be at the Contract Unit Price per gallon of free floating hydrocarbon product as measured with an interface probe placed in the tanker truck to discern free floating hydrocarbon product from water. The Contractor shall furnish an interface probe for the A/E’s use during the course of the construction project. The volume of the tanker truck shall be calculated prior to commencement of hauling. The Contractor shall provide mechanical means acceptable to the A/E so as to minimize the volume of excess water. This pay item shall be for the removal/disposal of free-floating hydrocarbon product. Price shall include all labor, materials, equipment, loading, hauling and disposal costs, and all other work necessary to complete the removal/disposal of free floating hydrocarbon product.

Measurement and payment for the use of oil absorbent pads/booms will be priced per each unit used to absorb free-floating hydrocarbon product as directed by the A/E.

Payment will be made under:

Item No. Removal/Disposal of FFHP - priced per gallon

Item No. Skimming/Transportation/Disposal of Absorbent Pads/Booms priced per each

160-4.7 DEWATERING/TREATMENT OF CONTAMINATED GROUNDWATER. Payment shall be at the hourly rental fee for the dewatering/treatment system and shall include labor and materials.

Payment will be made under:

Item No. Dewatering/Treatment of Contaminated Groundwater hourly unit flow rate <300 gpm

Item No. Dewatering/Treatment of Contaminated Groundwater hourly unit flow rate 300 gpm through 499 gpm

Item No. Dewatering/Treatment of Contaminated Groundwater hourly unit flow rate 500 gpm through 1000 gpm

END OF SECTION

Item P-211S
Lime Rock Base Course
SUPPLEMENT

The work to be performed under the classification of Lime Rock Base Course shall meet the requirements of Section P-211 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

DESCRIPTION

MATERIALS

DELETE article 211-2 number and **INSERT** 211-2.1

INSERT the Lime Rock Base Course Material Properties below

Lime Rock Base Course Material Properties[2]

	Oolitic	Non-Oolitic
Carbonates of calcium and magnesium[1]	70% minimum	75% minimum
Oxides of iron and aluminum[1]	Less than or equal to 2%	Less than or equal to 2%
Liquid limit	NA	Not greater than 35
Plasticity Index	NA	Not greater than 6
Organic or foreign matter	Not more than 0.5%	Not more than 0.5%
Lime Bearing Ratio (LBR)[3] at 0 to +1.5% optimum	125	125

1 The combined amount of carbonates, oxides, and silica shall be at least 97%. The material shall be non-plastic.
2 The chemical analysis of lime rock shall be tested in accordance with Florida Test Method FM 5-514.
3 FM 5-515, Florida Method of Test for Lime Rock Bearing Ratio. Test in the soaked condition.

Add article 211-2.2 **SAMPLING AND TESTING**

211-2.2 Sampling and Testing.

a. Aggregate base materials. The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 211-2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements. Determine the maximum dry density and optimum moisture content of the aggregate base in accordance with ASTM D1557 and provide with the submittal.

b. Gradation requirements. The Contractor shall take at least two aggregate base samples per day in the presence of the Resident Project Representative (RPR) to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in paragraph 211-2.1. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the RPR.

CONSTRUCTION METHODS

Add article 211-3.3.1 **REWORK EXISTING LIME ROCK BASE**

211-3.2.1 Rework Existing Lime Rock Base. Where existing lime rock base is exposed after full depth asphalt removal, it shall be scarified a minimum of four (4) inches and regraded to meet the grades shown on the plans. Where necessary, additional lime rock base shall be added to meet the grades shown on the plans. Obtain composite, representative samples of the lime rock base and determine the maximum dry density and optimum moisture content in accordance with ASTM D1557. Compaction and finishing shall be in accordance with paragraphs 211-3.4 and 211-3.5.

ADD to article 211-3.4 the following paragraphs:

The material shall meet gradation and moisture requirements prior to compaction. The layer shall be constructed in lifts as established in the control strip, but not less than 4 inches nor more than 12 inches of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

DELETE article 211-3.6 in its entirety and **INSERT:**

211-3.6 Finishing. After the watering and rolling of the base course, the entire surface shall be scarified to a depth of at least 3 inches and shaped to the exact crown and cross-section with a blade grader. The scarified material shall be rewetted and thoroughly rolled. Rolling shall continue until the base is bonded and compacted to a dense, unyielding mass, true to grade and cross-section. Scarifying and rolling of the surface of the base shall follow the initial rolling of the lime rock by not more than four (4) days. When the lime rock base is constructed in two layers, the scarifying of the surface shall be to a depth of at least 3 inches.

If cracks or checks appear in the base before the surface course is laid, the Contractor shall rescarify, reshape, water, add lime rock where necessary, and recompact. If the underlying material becomes mixed with the base course material, the Contractor shall, without additional compensation, remove, reshape, and recompact the mixture.

DELETE article 211-3.7 in its entirety and **INSERT:**

211-3.7 Surface tolerance. After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and recompacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

a. Smoothness. The finished surface shall not vary more than 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

b. Grade. The grade and crown shall be measured on the grid shown on the pavement elevation plans and shall be within +0 and -1/2 inch of the specified grade.

DELETE article 211-3.8 in its entirety and **INSERT:**

211-3.8 Acceptance sampling and testing. Lime rock base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1000 square yards. Sampling locations will be determined on a random basis per ASTM D3665. Thickness measurements are not applicable to areas where the existing lime rock base was reworked in accordance with paragraph 211-3.2.1.

a. Density. The Contractor's laboratory shall perform all density tests in the RPR's presence and provide the test results upon completion to the RPR for acceptance**.**

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per ASTM D1557. If the specified density is not attained, the entire area shall be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

b. Thickness. Depth tests shall be made by test holes or cores at least 3 inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the RPR for each area. Where the thickness is deficient by more than 1/2-inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

Delete the second sentence in article 211-3.10 and INSERT:

Priming of the base course shall be performed immediately after the completion of the base course

ADD to article 211-3.10 the following paragraph:

When material has been exposed to excessive rain conditions, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at the Contractor's expense.

ADD article 211-3.11 CONTROL STRIP

211-3.11 Control strip. The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the RPR. Upon acceptance of the control strip by the RPR, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

ADD article 211-3.12 WEATHER LIMITATIONS

211-3.12 Weather limitations. Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade is wet.

METHOD OF MEASUREMENT

DELETE Article 211-4.1 and 211-4.2 in its entirety and **INSERT** the following:

211-4.1 The quantity of 8” lime rock base course shall be the number of square yards of base material placed, bonded, and accepted in the completed base course by the RPR as complying with the plans and specifications.

211-4.2 The quantity of 15” lime rock base course shall be the number of square yards of base material placed, bonded, and accepted in the completed base course by the RPR as complying with the plans and specifications.

211-4.3 The quantity of rework existing lime rock base course shall be the number of square yards of existing base material reworked and accepted by the RPR as complying with the plans and specifications.

211-4.4 The quantity of variable thickness lime rock base course shall be the number of cubic yards of lime rock base course placed in areas of reworked existing lime rock base course. The quantity of lime rock shall be measured in its final position by means of average end areas between the surface surveyed after asphalt removal and the finished surface of the lime rock base course. The Contractor shall provide weighbills of all delivered lime rock to the RPR at the end of each day.

BASIS OF PAYMENT

DELETE article 211-5.1 in its entirety and **INSERT** the following:

211-5.1 Payment shall be made at the contract unit price per square yard for 8” lime rock base course. This price shall be full compensation for furnishing all materials and for all preparation, hauling, placing, moisture-conditioning, grading, compacting, and testing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

The cost of removing cracks and checks including the labor, and the additional lime rock necessary for crack elimination, will not be paid for separately but shall be included in the contract price per square yard for lime rock base course.

211-5.2 Payment shall be made at the contract unit price per square yard for 15” lime rock base course. The price shall be full compensation for furnishing all materials and for all preparation, hauling, placing, moisture-conditioning, grading, compacting, and testing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

The cost of removing cracks and checks including the labor, and the additional lime rock necessary for crack elimination, will not be paid for separately but shall be included in the contract price per square yard for lime rock base course.

211-5.3 Payment shall be made at the contract unit price per square yard for rework existing lime rock base course. The price shall be full compensation for scarifying, regrading, moisture-conditioning, recompacting, and testing, and for all labor equipment, tools, and incidentals necessary to complete the item.

The cost of removing cracks and checks including the labor, and the additional lime rock necessary for crack elimination, will not be paid for separately but shall be included in the contract price per square yard for lime rock base course.

211-5.4 Payment shall be made at the contract unit price per cubic yard for variable thickness lime rock base course. The price shall be full compensation for furnishing, hauling, and placing of these materials, and for all labor equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-211-5.1	8” Lime Rock Base Course - per square yard
Item P-211-5.2	15” Lime Rock Base Course - per square yard
Item P-211-5.3	Rework Existing Lime Rock Base Course – per square yard
Item P-211-5.4	Variable Thickness Lime Rock Base Course – per cubic yard

INSERT the references (publications) below into the TESTING REQUIREMENTS Section

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

END OF ITEM P-211

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SECTION P-211 LIMEROCK BASE COURSE

DESCRIPTION

211-1.1 The work specified under this Section shall consist of base courses composed of limerock constructed on the prepared underlying course in accordance with these specifications and shall conform to the dimensions and typical cross section shown on the Plans, or as directed by the Architect/Engineer.

211-1.2 The Contractor shall be solely responsible for all work performed and quality control procedures performed under this Item.

The County will retain the services of a Professional Testing Laboratory referred to hereinafter as the "Project Testing Laboratory," to perform independent testing to verify the Contractor's quality control performance. The Project Testing Laboratory will perform testing at the direction of the Architect/Engineer and the Project Testing Laboratory will perform all acceptance tests. The County will pay for all testing performed by its Project Testing Laboratory.

MATERIALS

211-2 The limerock base course material shall consist of fossiliferous limestone of uniform quality, and shall not contain hard or flinty pieces which will cause a rough surface containing pits and pockets. The rock shall show no tendency to "air slack" or undergo chemical change when exposed to the weather. The material when watered and rolled shall be capable of being compacted into a dense and well-bonded base.

The limerock shall be newly mined, crushed and graded Oolitic limerock meeting the following requirements:

> Carbonates of calcium and magnesium - not less than 70%.
>
> Oxides of iron and aluminum - nor more than 2%.
>
> The combined amount of carbonates, oxides, and silica shall be at least 97%.

The material shall be non-plastic, determined in accordance with ASTM D4318 and as modified in DCAD T-611.

The chemical analysis of limerock shall consist of determining the silica insoluble, iron oxide, and alumina by solution of the sample in hydrochloric (HCl) acid, evaporating, dehydrating, redissolving the residue, and neutralizing with ammonium hydroxide, filtering, washing, and igniting the residue limerock. The difference between this insoluble matter and 100% is reported as carbonates of calcium and magnesium and organic matters.

The limerock shall not contain more than 1.0% of organic materials such as roots, leaf mold, organic, or foreign matter and shall be obtained from pits from which all overburden has been removed previous to blasting and quarrying. Organic content shall be determined in accordance with FDOT test Designation FM 5-514 "Test Method for Carbonates and Organic Matter in Limerock" (a copy of FDOT FM 5-514 is incorporated as Appendix I to Section T-611).

The gradation of the limerock shall meet the following requirements:

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
3-1/2 inch *(90 mm)*	100
3/4 inch *(19 mm)*	50-100

All material shall be graded uniformly down to dust.

All fine material shall consist entirely of dust of fracture.

CONSTRUCTION METHODS

211-3.1 SOURCE OF SUPPLY. All work involved in cleaning and stripping pits, including the handling of unsuitable material shall be performed by the Contractor. Limerock shall be produced and supplied by a Florida DOT approved limerock supplier(s) located in the Dade County area. An inspection of the producer's operation will be made by the Architect/Engineer. Approval of the source of the limerock does not relieve the contractor in any way of the responsibility for delivery at the job site of limerock that meets the requirements specified herein. The stockpile from where the limerock will be obtained for work under this Section will be sampled and tested by the Project Testing Laboratory and the County's initial approval of the material shall be obtained prior to delivery of any limerock to the job site. The pits shall be operated in such a manner that a clean and uniform material will be secured.

211-3.2 EQUIPMENT. All equipment necessary for the proper construction of this work shall be on the project, in first-class working condition, and approved by the **Architect/**Engineer before commencing work under this Section.

211-3.3 PREPARING UNDERLYING COURSE. The underlying course shall be checked and accepted by the Architect/Engineer before placing and spreading operations are started. Any ruts or soft yielding places shall be corrected before the base limerock course is placed thereon. Material shall not be placed on frozen subgrade.

211-3.4 PLACING AND SPREADING. All base course material shall be placed on the prepared underlying course and compacted in layers to the thickness shown on the Plans. The depositing and spreading of the material on the prepared course or on a completed layer shall progress without interruption from start to finish of a construction area. The material shall be deposited and spread in lanes in a uniformly blended layer, without segregation. Materials shall be placed in layers, to such loose depth that, when compacted, each layer shall have the required thickness. When more than one layer is required, the construction procedure described herein shall apply similarly to each layer, excepting the scarifying, shaping and recompacting the surface which shall apply to only the top layer.

To protect the underlying course and to insure proper drainage, the spreading of the limerock shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

The rock shall be transported over limerock previously placed, dumped at the end of the preceding spread and spread uniformly with approved mechanical spreaders especially constructed for this purpose. In no case shall limerock be dumped directly onto the underlying course except as specifically approved in writing by the Architect/Engineer. During the dumping and spreading operations, the limerock shall be brought to the proper moisture content to obtain maximum density. If water is added, it shall be uniformly mixed to the full depth of the course by discing or scarifying. All segregated areas of fine or coarse limerock shall be removed and replaced with well-graded limerock, and approved by the **Architect/**Engineer. Limerock shall not be spread when the subgrade is in an unsuitable condition.

The limerock base course shall be constructed in a layer not less than 4 inches *(100 mm)* nor more than 6 inches *(150 mm)* of compacted thickness. The base course shall be constructed in lanes or strips parallel with the centerline of the pavement.

The Contractor shall not employ any operation that will cause the incorporation of subgrade, subbase, or shoulder material in the limerock.

211-3.5 ROLLING. Immediately after completion of the spreading operations of each layer, the base material shall be uniformly compacted to the required density. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density during the rolling, the material shall be manipulated and blended to obtain a uniformly graded mass.

The field density of the compacted material shall be at least 100 percent of the maximum density at optimum moisture of laboratory test specimens prepared from samples of the limerock base material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D1557 and AASHTO T-180 as modified in DCAD T-611. The in-place field density shall be determined in accordance with ASTM D 1556. Prior to and during compaction, water shall be uniformly applied to maintain moisture content consisted with density requirements.

211-3.6 FINISHING BASE COURSE. After the initial watering and rolling of the top layer of the limerock base course, the entire surface shall be scarified to a depth of at least 3 inches *(75 mm)*, watered, bladed, rolled and shaped to the exact crown and cross section with a blade grader, as required to obtain a smooth, even surface and until the top layer is compacted into a dense, unyielding mass meeting density requirements and true to grade and cross section. The scarifying and rolling of the surface of the base shall follow the initial rolling of the limerock by not more than 4 days.

As an alternate to meeting grades and cross-sections by blade grading as specified above, the Contractor may construct, roll, blade and shape the top layer of the base course to an elevation above the proposed final grade, then cut it to true grade and cross sections using automatic grading or milling machines.

If, in the opinion of the Architect/Engineer, the surface of the base is glazed or cemented to the extent that the prime coat could not penetrate properly, and after determining that the condition of the base meets all requirements, he will direct that the surface of the base be hard-planed with a blade grader and broomed immediately prior to the application of the prime coat. This hard-planing shall be done in such a manner that only the glazed or cemented surface is removed, leaving a granular or porous condition that will allow free penetration of the prime material. The material planed from the base shall be removed from the base area.

If at any time the underlying material becomes churned up and mixed with the base course material, the Contractor shall, without additional compensation, dig out and remove the mixture, reshape and compact the underlying course, replace the materials removed with clean limerock which shall be watered and rolled until satisfactorily compacted.

Where cracks, checks, or failures appear in the base, either before or after priming and before the surface course is laid, the Contractor shall remove such cracks, checks, or failures by rescarifying, reshaping, watering, rolling, and adding limerock where necessary.

211-3.7 SURFACE TOLERANCE. After the course has been shaped and completely compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified, reshaped, recompacted, and otherwise manipulated as required until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 3/8 inch *(9.4 mm)* from a 16-foot *(4.8 m)* straightedge when applied to the surface parallel with, and at right angles to, the centerline. In testing surface of the harder limerocks, measurement of clearances from the straightedge shall not include small holes caused by individual pieces being pulled out by the hard planer.

The finished surface of the limerock base course shall not vary from the gradeline, elevations, and cross sections shown on the Plans by more than 5/8 inch *(16 mm)*. The Contractor shall correct base course areas varying in excess of this amount by removing or adding limerock, scarifying, watering, blading, rolling and compacting it to within the specified 5/8 inch *(16 mm)* tolerance.

211-3.8 THICKNESS. The thickness of the base course shall be determined by depth tests or elevations [measured to the nearest 0.01 foot *(3 mm)*] taken at intervals in such a manner that each test shall represent 300 square yards *(275 square meters)*, or as otherwise directed by the Architect/Engineer. The depth tests shall be made by test holes through the base at least 3 inches *(75 mm)* in diameter. Where the base deficiency is more than 1/2 inch *(12.5 mm)*, and correction cannot be made by adding limerock without exceeding grade tolerance, the Contractor shall correct such areas by removing deficient base course, correcting the underlying course and reconstructing the base course. Where correction can be made by adding limerock without exceeding grade tolerance correction may be made by scarifying and adding limerock tapered a distance of 100 feet *(30 m)* in each direction from the edge of the deficient area for each inch of limerock added. The affected area shall be scarified, watered, bladed, rolled, and shall be compacted to the required density, thickness, and cross section. The thickness of the base in the affected area shall be remeasured by depth tests or elevations. The final base thickness of the reconditioned area shall be used to determine the average job thickness.

The average job thickness shall be the average of the depth measurement as above outlined and shall be within 1/4 inch *(6 mm)* of the thickness shown on the typical cross section. On individual depth measurements, thicknesses more than 1/2 inch *(12.5 mm)* in excess of that shown on the plans shall be considered as specified thickness plus 1/2 inch *(12.5 mm)* in computing the average job thickness. The Contractor shall replace the limerock removed from test holes.

211-3.9 PROTECTION. Work on the base course shall not be accomplished during freezing temperatures nor when the subgrade is wet.

Hauling equipment may be routed over completed portions of the limerock base course, provided no damage results and provided that such equipment is routed over the full width of the base course to avoid rutting or uneven compaction. however, the Architect/Engineer shall have full and specific authority to stop all hauling over completed or partially completed base course when, in the Architect/Engineer's opinion, such hauling is causing damage. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor.

211-3.10 MAINTENANCE. Following the completion of the base course, the Contractor shall perform all maintenance work necessary to keep the base course in a condition satisfactory for priming. Priming of the base course shall be performed within two (2) weeks after the completion of the base course. After priming, the surface shall be kept clean and free from foreign material. The limerock base course shall be properly drained at all times. If cleaning is necessary, or if the prime coat becomes disturbed, any work or restitution necessary to maintain the limerock base course in an acceptable condition shall be performed by and at the expense of the Contractor.

METHOD OF MEASUREMENT

211-4.1 The quantity of limerock base course to be paid for shall be the number of cubic (yards) *(meters)* of base material placed, bonded, and accepted in the completed base course. The quantity of base course material shall be measured in final position, based upon depth tests taken as directed by the Architect/Engineer, at the rate of 1 depth test for each 300 square yards *(275 square meters)* of base course, or by means of average end areas on the complete work computed from elevations to the nearest 0.01 foot *(3 mm)*. On individual depth measurements, thicknesses more than 1/2 inch *(12.5 mm)* in excess of that shown on the plans shall be considered as the specified thickness plus 1/2 inch *(12.5 mm)* in computing the volume of the limerock base course for payment.

211-4.2 The quantity of limerock base course to be paid for shall be the area, in square (yards) *(meters)*, of limerock base of the specified thickness, in the finished work constructed, completed and accepted in accordance with the Plans and these Specifications. The average thickness of the limerock base course material shall be measured in final position, based upon depth tests taken as directed by the Architect/Engineer, at the rate of 1 depth test for each 300 square yards *(275 square meters)* of base course, or by means of average end areas on the complete work computed from elevations to the nearest 0.01 foot *(3 mm)*. On individual depth measurements, thicknesses more than 1/2 inch *(12.5 mm)* in excess of that shown on the Plans shall be considered as the specified thickness plus 1/2 inch *(12.5 mm)* in computing the thickness of the limerock base course.

BASIS OF PAYMENT

211-5.1 Payment shall be made at the contract unit price per cubic (yard) *(meter)* or per square (yard) *(meter)* for limerock base course. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work covered by this Section.

The cost of removing cracks and checks and for filling core holes including the labor and material for repriming, and the additional limerock necessary for crack elimination, will not be paid for separately but shall be included in the contract price per cubic (yard) *(meter)* or per square (yard) *(meter)* for limerock base course.

Payment will be made under:

Item	Limerock Base Course	per Cubic (Yard) *(Meter)*
Item	Limerock Base Course (___") *(___ cm)* Thick	per Square (Yard) *(Meter)*

TESTING REQUIREMENTS

ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D 1556	Density of Soil in Place by the Sand-Cone Method
ASTM D 1557 /AASHTO T 180	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 kg) Rammer and 18-in (457 mm) Drop
ASTM 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
DCAD T-611	DCAD Compaction Control and Limerock Testing.

END OF SECTION

Item P-401S
Asphalt Mix Pavement

SUPPLEMENT

The work to be performed under the classification of Asphalt Mix Pavement shall meet the requirements of Section P-401 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

DELETE the entire specification except requirements of section 401-6.2 (Testing Laboratory) and INSERT the following:

DESCRIPTION

401-1.1 This item shall consist of pavement courses composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared base or stabilized course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

MATERIALS

401-2.1 Aggregate. Aggregates shall consist of crushed stone, crushed gravel, screenings, natural sand, and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 (4.75 mm) sieve. Fine aggregate is the material passing the No. 4 (4.75 mm) sieve.

a. Coarse aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Coarse aggregate material requirements are given in the table below.

Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0 % maximum	ASTM C142
Percentage of Fractured Particles	Minimum 75% by weight of particles with at least two fractured faces and 85% with at least one fractured face[1]	ASTM D5821
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 [2]	ASTM D4791

[1] The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

[2] A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

b. Fine aggregate. Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel and shall be free from coatings of clay, silt, or other objectionable matter. Natural (non-manufactured) sand may be used to obtain the gradation of the fine aggregate blend or to improve the workability of the mix. Fine aggregate material requirements are listed in the table below.

Fine Aggregate Material Requirements

Material Test	Requirement	Standard
Liquid limit	25 maximum	ASTM D4318
Plasticity Index	4 maximum	ASTM D4318
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0% maximum	ASTM C142
Sand equivalent	45 minimum	ASTM D2419
Natural Sand	0% to 15% maximum by weight of total aggregate	ASTM D1073

c. Sampling. ASTM D75 shall be used in sampling coarse and fine aggregate.

401-2.2 Mineral filler. Mineral filler (baghouse fines) may be added in addition to material naturally present in the aggregate. Mineral filler shall meet the requirements of ASTM D242.

Mineral Filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	ASTM D4318

401-2.3 Asphalt binder. Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 76-22 and meet the requirements in the table below.

Asphalt Binder PG Plus Test Requirements

Material Test	Requirement	Standard
Elastic Recovery	75% minimum	ASTM D6084[1]

[1] Follow procedure B on RTFO aged binder.

401-2.4 Anti-stripping agent. Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the Department of Transportation of the State in which the project is located.

COMPOSITION

401-3.1 Composition of mixture(s). The asphalt mix shall be composed of a mixture of aggregates, filler and anti-strip agent if required, and asphalt binder. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

401-3.2 Job mix formula (JMF) laboratory. The laboratory used to develop the JMF shall possess a current certificate of accreditation, listing ASTM D3666 from a national accrediting authority and all test methods required for developing the JMF; and be listed on the accrediting authority's website. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Resident Project Representative (RPR) prior to start of construction and with the JMF submittal.

401-3.3 Job mix formula (JMF). No asphalt mixture shall be placed until an acceptable mix design has been submitted to the RPR for review and accepted in writing. The RPR's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.

The JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 401-3.2. The asphalt mixture shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared and compacted using the gyratory compactor in accordance with ASTM D6925.

Should a change in sources of materials be made, a new JMF must be submitted to the RPR for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the RPR and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new control strip when required by the RPR, will be borne by the Contractor.

The RPR may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

The JMF shall be submitted in writing by the Contractor at least 30 days prior to the start of paving operations. The JMF shall be developed after Notice to Proceed (NTP) is issued and using aggregates and asphalt binder proposed for project use.

The JMF shall be dated, and stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

- Manufacturer's Certificate of Analysis (COA) for the asphalt binder used in the JMF in accordance with paragraph 401-2.3. Certificate of asphalt performance grade is with modifier already added, if used and must indicate compliance with ASTM D6373. For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.
- Manufacturer's Certificate of Analysis (COA) for the anti-stripping agent if used in the JMF in accordance with paragraph 401-2.4.
- Certified material test reports for the coarse and fine aggregate and mineral filler in accordance with paragraphs 401-2.1 and 401-2.2, including source location and aggregate size/type. Certified material test reports are required for each individual aggregate used in the JMF. Aggregate testing shall be conducted after Notice to Proceed (NTP) is issued.
- Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.
- Specific Gravity and absorption of each coarse and fine aggregate.
- Percent natural sand.
- Percent fractured faces.
- Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- Percent of asphalt.
- Number of gyrations
- Laboratory mixing and compaction temperatures.
- Supplier-recommended field mixing and compaction temperatures.
- Plot of the combined gradation on a 0.45 power gradation curve.
- Graphical plots of air voids, voids in the mineral aggregate (VMA), and unit weight versus asphalt content in accordance with Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Data used to develop the graphical plots shall also be provided. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.
- Tensile Strength Ratio (TSR).
- Type and amount of Anti-strip agent when used.
- Asphalt Pavement Analyzer (APA) results.
- Date the JMF was developed. Mix designs that are not dated or which are dated prior to NTP shall not be accepted.

Table 1. Asphalt Design Criteria

Test Property	Value	Test Method
Number of gyrations	75	
Air voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 2	ASTM D6995
Tensile Strength Ratio (TSR)[1]	not less than 80 at a saturation of 70-80%	ASTM D4867
Asphalt Pavement Analyzer (APA)[2]	Less than 10 mm @ 4000 passes	AASHTO T340[4] at 250 psi hose pressure at 64°C test temperature

[1] Test specimens for TSR shall be compacted at 7 ± 1.0 % air voids.

[2] Test specimens for APA shall be compacted at 3.5% air voids.

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 2 when tested in accordance with ASTM C136 and ASTM C117.

The gradations in Table 2 represent the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 2. Aggregate - Asphalt Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25.0 mm)	--
3/4 inch (19.0 mm)	100
1/2 inch (12.5 mm)	90-100
3/8 inch (9.5 mm)	72-88
No. 4 (4.75 mm)	53-73
No. 8 (2.36 mm)	38-60
No. 16 (1.18 mm)	26-48
No. 30 (600 µm)	18-38
No. 50 (300 µm)	11-27
No. 100 (150 µm)	6-18
No. 200 (75 µm)	3-6
Minimum Voids in Mineral Aggregate (VMA)[1]	15

Sieve Size	Percentage by Weight Passing Sieve
Asphalt Percent:	
Stone or gravel	5.0-7.5
Recommended Minimum Construction Lift Thickness	2 inch

[1]To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

401-3.4 Reclaimed asphalt pavement (RAP). RAP shall not be used.

401-3.5 Control Strip. Full production shall not begin until an acceptable control strip has been constructed and accepted in writing by the RPR**.** The Contractor shall prepare and place a quantity of asphalt according to the JMF. The underlying grade or pavement structure upon which the control strip is to be constructed shall be the same as the remainder of the course represented by the control strip.

The Contractor will not be allowed to place the control strip until the Contractor quality control program (CQCP), showing conformance with the requirements of paragraph 401-5.1, has been accepted, in writing, by the RPR.

The control strip will consist of at least 250 tons or 1/2 sublot, whichever is greater. The control strip shall be placed in two lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back in accordance with paragraph 401-4.14 using the same procedure that will be used during production. The cold joint for the control strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 160°F. The equipment used in construction of the control strip shall be the same type, configuration and weight to be used on the project.

The control strip will be considered acceptable by the RPR if the gradation, asphalt content, and VMA are within the action limits specified in paragraph 401-5.5a; and Mat density greater than or equal to 94.5%, air voids 3.5% +/- 1%, and joint density greater than or equal to 92.5%. The RPR will have the discretion to retrieve additional cores in suspected deficient areas for acceptance of the control strip. In addition, the control strip will be evaluated based on the uniformity of the mat and joints in accordance with all requirements of sections 401-4, 401-5, and 401-6, which can include segregation, roller marks, check cracks, oil spills, and other surface deficiencies. A control strip placement with surface deficiencies can be considered unacceptable regardless of acceptance testing.

If the control strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another control strip shall be placed. Unacceptable control strips shall be removed at the Contractor's expense.

The control strip will be considered one lot for payment and shall be evaluated based upon a minimum of 3 sublots. Payment will only be made for an acceptable control strip in accordance with paragraph 401-8.1 using a lot pay factor equal to 100.

CONSTRUCTION METHODS

401-4.1 Weather limitations. The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements shall not be waived by the RPR.

Table 4. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	°F	°C
3 inches or greater	40 [1]	4
Greater than 2 inches but less than 3 inches	45	7

401-4.2 Asphalt plant. Plants used for the preparation of asphalt shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 including the following items.

a. Inspection of plant. The RPR, or RPR's authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

b. Storage bins and surge bins. The asphalt mixture stored in storage and/or surge bins shall meet the same requirements as asphalt mixture loaded directly into trucks. Asphalt mixture shall not be stored in storage and/or surge bins for a period greater than twelve (12) hours. If the RPR determines there is an excessive heat loss, segregation, or oxidation of the asphalt mixture due to temporary storage, temporary storage shall not be allowed.

401-4.3 Aggregate stockpile management. Aggregate stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the asphalt batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

401-4.4 Hauling equipment. Trucks used for hauling asphalt shall have tight, clean, and smooth metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the RPR. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

401-4.4.1 Material transfer vehicle (MTV). Material transfer vehicles used to transfer the material from the hauling equipment to the paver, shall use a self-propelled, material transfer vehicle with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

401-4.5 Asphalt pavers. Asphalt pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of asphalt that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation.

If the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in paragraph 401-4.12. Pavers with screed extensions shall place the mix at the extension portion with the same characteristics in terms of texture, smoothness, and pre-compaction as the material placed by the main screed. Pavers with screed extensions shall provide a continuous auger for the full width of the screed. Pavers that do not meet the uniform requirement across the entire width will not be allowed to be used for paving.

401-4.6 Rollers. The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, clean, and capable of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

401-4.7 Density device. The Contractor shall have on site a nuclear density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the RPR upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician. Density readings from the nuclear gauge are not used for determination of lot acceptance, pay factors, or rejection.

401-4.8 Preparation of asphalt binder. The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F when added to the aggregate.

401-4.9 Preparation of mineral aggregate. The aggregate for the asphalt shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

401-4.10 Preparation of Asphalt mixture. The aggregates and the asphalt binder shall be weighed or metered and mixed in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

401-4.11 Application of Prime and Tack Coat. Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris.

A bituminous single surface treatment in accordance with Item P-609 shall be applied to lime rock base prior to placing the asphalt mixture.

A tack coat shall be applied in accordance with Item P-603 to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

401-4.12 Laydown plan, transporting, placing, and finishing. Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the equipment; sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the RPR.

Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

Prior to paving over a previous lift, all quality control and acceptance testing required by this specification shall be complete and in conformance with the requirements herein. Any asphalt placed over a lot which has not been accepted by the RPR is at the Contractor’s risk and will be removed and replaced if there are deficiencies in the underlying lift.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with P-603 before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one way slope unless shown otherwise on the laydown plan as accepted by the RPR. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width as listed below except where edge lanes require less width to complete the area. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension. The MTV shall operate in a lane adjacent to the paver, not in front of the paver.

- Runway – 25 feet
- Taxiways – 15 feet

The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least one foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt may be spread and luted by hand tools.

The RPR may at any time, reject any batch of asphalt, on the truck or placed in the mat, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the RPR, and if it can be demonstrated in the laboratory, in the presence of the RPR, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Areas of segregation or cracking in the surface course, as determined by the RPR, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified in paragraph 401-3.3, Table 2 for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet long.

401-4.13 Compaction of asphalt mixture. After placing, the asphalt mixture shall be thoroughly and uniformly compacted by self-propelled rollers. The surface shall be compacted as soon as possible when the asphalt has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any surface defects and/or displacement occurring as a result of the roller, or from any other cause, shall be corrected at the Contractor's expense.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the asphalt to the roller, the wheels shall be equipped with a scraper and kept moistened with water as necessary.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power tampers. Identify these locations on the laydown plan and provide the proposed compaction equipment.

Any asphalt that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

401-4.14 Joints. The formation of all joints shall be made to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh asphalt against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F; or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw to expose a compacted, clean, sound, uniform vertical surface for the full depth of the course. Use of joint heaters in lieu of cutting back the joint is not allowed. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with P-603 shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

401-4.15 Saw-cut grooving. Saw-cut grooves shall be provided as specified in Item P-621.

401-4.16 Diamond grinding. Diamond grinding shall be completed prior to pavement grooving. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least 3 feet wide. The saw blades shall be 1/8-inch wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that cause ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. Contractor shall demonstrate to the RPR that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. If diamond grinding is required, the Contractor shall submit a grinding plan to the RPR for approval prior to grinding. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding. Surface treatment is incidental to this specification and will not be paid separately.

401-4.17 Nighttime paving requirements. The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan shall be submitted by the Contractor and approved by the RPR prior to the start of any nighttime work. All work shall be in accordance with the approved CSPP and lighting plan.

CONTRACTOR QUALITY CONTROL (CQC)

401-5.1 General. The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Division 1 Section 014516.13. No partial payment will be made for materials without an approved CQCP. The program shall address all elements that affect the quality of the pavement including but not limited to mix production, transportation, placing, rolling pattern, compaction, joints, smoothness, defects, etc.

401-5.2 Contractor quality control (QC) facilities. The Contractor shall provide or contract for testing facilities in accordance with Division 1 Section 014516.13. The QC testing laboratory performing these tests will be accredited in accordance with ASTM D3666. The QC laboratory accreditation will be current and listed on the accrediting authority's website. All test methods required for quality control sampling and testing will be listed on the lab accreditation.

The RPR shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The RPR will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

401-5.3 Contractor QC testing. The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP.

a. Asphalt content. A minimum of two tests shall be performed per day in accordance with ASTM D6307 or ASTM D2172 for determination of asphalt content. When using ASTM D6307, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.

b. Gradation. Aggregate gradations shall be determined a minimum of twice per day from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136, and ASTM C117.

c. Moisture content of aggregate. The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with ASTM C566.

d. Moisture content of asphalt. The moisture content shall be determined once per day in accordance with AASHTO T329 or ASTM D1461.

e. Temperatures. Temperatures shall be checked and recorded, at least four times per day, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.

f. In-place density monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

g. Smoothness for Contractor Quality Control.

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12-foot "straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot straightedge approved by the RPR. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated in accordance with the above paragraphs.

(1) Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the RPR. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

(2) Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 ft or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

(3) Aerial measurement. The Contractor shall test any suspected low spots in the final surface course by flooding the pavement with water, in the presence of the RPR.

Deviations on the final surface course in any direction that will trap water greater than 1/4 inch shall be corrected with diamond grinding per paragraph 401-4.16 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 401-6.1d(3). Areas that have been ground shall be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area. Surface treatment is incidental to this specification and will not be paid separately.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

h. Grade. Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to and after the placement of the first lift and after placement of the surface lift.

Measurements will be taken at appropriate gradelines, as a minimum at center and edges of paving lane, including transverse spacing shown on the pavement elevation plans, and longitudinal spacing as shown on the pavement elevation plans. The final surface of the pavement will not vary from the spot elevations shown on the pavement elevation plans by more than 1/2 inch vertically. The documentation will be provided by the Contractor to the RPR by the end of the following working day.

Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/4 inch less than the thickness specified on the plans. Grinding shall be in accordance with paragraph 401-4.16.

The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus ½ inch and replacing with new material. Skin patching is not allowed.

401-5.4 Sampling. When directed by the RPR, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401-5.5 Control charts. The Contractor shall maintain linear control charts for both individual measurements and range (i.e. difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each day will be calculated and monitored by the QC laboratory.

Control charts shall be posted in a location satisfactory to the RPR and kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the RPR may suspend production or acceptance of the material.

a. Individual measurements. Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits for Individual Measurements

Sieve	Action Limit	Suspension Limit
3/4 inch (19.0 mm)	±6%	±9%
1/2 inch (12.5 mm)	±6%	±9%
3/8 inch (9.5 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (300 µm)	±3%	±4.5%
No. 200 (75 µm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
Minimum VMA	-0.5%	-1.0%

b. Range. Control charts shall be established to control gradation process variability. The range shall be plotted as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Control Chart Limits Based on Range

Sieve	Suspension Limit
1/2 inch (12.5 mm)	11%
3/8 inch (9.5 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (300 µm)	6%
No. 200 (75 µm)	3.5%
Asphalt Content	0.8%

c. Corrective Action. The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

401-5.6 QC reports. The Contractor shall maintain records and shall submit reports of QC activities daily, in accordance with Division 1 Section 014516.13.

MATERIAL ACCEPTANCE

401-6.1 Acceptance sampling and testing. Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the RPR at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor. Quality assurance testing shall be completed by end of the following working day after samples are obtained.

a. Quality assurance (QA) testing laboratory. The QA testing laboratory performing these acceptance tests will be accredited in accordance with ASTM D3666. The QA laboratory accreditation will be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing will be listed on the lab accreditation.

b. Lot size. A standard lot will be equal to one day's production divided into approximately equal sublots of between 400 to 600 tons. When only one or two sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next day.

Where more than one plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.

c. Asphalt air voids. Plant-produced asphalt will be tested for air voids on a sublot basis.

(1) Sampling. Material from each sublot shall be sampled in accordance with ASTM D3665. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF.

(2) Testing. Air voids will be determined for each sublot in accordance with ASTM D3203 for a set of three compacted specimens prepared in accordance with ASTM D6925. Percent air voids shall be reported to two (2) decimal places.

d. In-place asphalt mat and joint density. Each sublot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).

(1) Sampling. The Contractor will cut minimum 5 inch diameter samples in accordance with ASTM D5361. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one day after sampling in a manner acceptable to the RPR. Use of cold patch asphalt to fill core holes is not allowed.

(2) Bond. Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by the RPR to determine the extent of unbonded areas. Unbonded areas shall be removed by milling, full depth of the unbonded lift(s), and replaced at no additional cost as directed by the RPR.

(3) Thickness. Thickness of each lift of surface course will be evaluated by the RPR for compliance to the requirements shown on the plans after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point will not be more than 1/4 inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or sublot shall be corrected by the Contractor at their expense by removing the deficient area and replacing with new pavement. The Contractor, at their expense, may take additional cores as approved by the RPR to circumscribe the deficient area.

(4) Mat density. One core shall be taken from each sublot. Core locations will be determined, and marked in the field, by the RPR in accordance with ASTM D3665. Cores for mat density shall not be taken closer than one foot from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the TMD for that sublot.

(5) Joint density. One core centered over the longitudinal joint shall be taken for each sublot that has a longitudinal joint. Core locations will be determined, and marked in the field, by the RPR in accordance with ASTM D3665. The bulk specific gravity of each core sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at joints formed between lots will be the lower of the average TMD values from the adjacent lots.

401-6.2 Acceptance criteria.

a. General. Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the asphalt and completed pavements: air voids, mat density, joint density, grade, and Profilograph roughness**.** Acceptance is also based on the surface being free of segregation, roller marks, check cracks, oil spills, and other surface deficiencies.

b. Air Voids and Mat density. Acceptance of each lot of plant produced material for mat density and air voids will be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment will be determined in accordance with paragraph 401-8.1.

c. Joint density. Acceptance of each lot of plant produced asphalt for joint density will be based on the PWL. If the PWL of the lot is equal to or exceeds 90%, the lot will be considered acceptable. If the PWL is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor shall cease operations and until the reason for poor compaction has been determined. If the PWL is less than 71%, the pay factor for the lot used to complete the joint will be reduced by five (5) percentage points. This lot pay factor reduction will be incorporated and evaluated in accordance with paragraph 401-8.1.

d. Grade. The final finished surface of the pavement shall be surveyed to verify that the grade elevations and cross-sections shown on the plans do not deviate more than 1/2 inch vertically.

Cross-sections of the pavement shall be taken at the grid shown on the pavement elevation plans.

The survey and documentation shall be stamped and signed by a licensed surveyor. Sublots that do not meet grade for over 25% of the sublot shall be removed and replaced full depth of the surface lift at the Contractor's expense.

e. Profilograph roughness for QA Acceptance. The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. Profilograph testing is only required on the runway. The Contractor, in the presence of the RPR shall perform a profilograph roughness test on the completed project with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within 48 hours of profilograph roughness tests.

The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Provide the operator's current certification a minimum of 7 days prior to conducting the profilograph testing. Profilograms shall be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm) equals one inch (25 mm). Profilograph shall be performed one foot right and left of project centerline and 15 feet (4.5 m) right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding per paragraph 401-4.16 or by removing and replacing full depth of surface course as directed by the RPR. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less.

401-6.3 Percentage of material within specification limits (PWL). The PWL will be determined in accordance with procedures specified in Division 1 Section 014530 Specification. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 5.

Table 5. Acceptance Limits for Air Voids and Density

Test Property	Pavements Specification Tolerance Limits	
	L	**U**
Air Voids Total Mix (%)	2.0	5.0
Surface Course Mat Density (%)	92.8	-
Joint density (%)	90.5	--

a. Outliers. All individual tests for mat density and air voids will be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and the PWL will be determined using the remaining test values. The criteria in Table 5 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (%), 1.30; Joint Density (%), 1.55.

The Contractor should note that (1) 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 94.5% with 1.30% or less variability, (2) 90 PWL is achieved when consistently producing joints with an average joint density of at least 92.5% with 1.55% or less variability.

401-6.4 Resampling pavement for mat density.

a. General. Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the RPR. A retest will consist of all the sampling and testing procedures contained in paragraphs 401-6.1d and 401-6.2b. Only one resampling per lot will be permitted.

(1) A redefined PWL will be calculated for the resampled lot. The number of tests used to calculate the redefined PWL will include the initial tests made for that lot plus the retests.

(2) The cost for resampling and retesting shall be borne by the Contractor.

b. Payment for resampled lots. The redefined PWL for a resampled lot will be used to calculate the payment for that lot in accordance with Table 6.

c. Outliers. Check for outliers in accordance with ASTM E178, at a significance level of 5%.

METHOD OF MEASUREMENT

401-7.1 Measurement. Asphalt shall be measured by the number of tons of asphalt used in the accepted work. Batch weights or truck scale weights will be used to determine the basis for the tonnage. Payment will not be made for the amount of asphalt mix pavement which is greater than plan thickness, except where used to correct for scabbing, unless authorized in advance by the RPR. The amount of asphalt used to correct for scabbing shall be documented via survey in accordance with P-101 requirements. Refer to Item P-101 for additional requirements regarding scabbing.

BASIS OF PAYMENT

401-8.1 Payment. Payment for a lot of asphalt meeting all acceptance criteria as specified in paragraph 401-6.2 shall be made based on results of tests for mat density and air voids. Payment for acceptable lots shall be adjusted according to paragraph 401-8.1c for mat density and air voids; and paragraph 401-6.2c for joint density, subject to the limitation that:

a. The total project payment for plant mix asphalt pavement shall not exceed 100 percent of the product of the contract unit price and the total number of tons of asphalt used in the accepted work.

b. The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

c. Basis of adjusted payment. The pay factor for each individual lot shall be calculated in accordance with Table 6. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71% then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 401-8.1a. Payment in excess of 100% for accepted lots of asphalt shall be used to offset payment for accepted lots of asphalt pavement that achieve a lot pay factor less than 100%.

Sublots which do not meet grade in accordance with paragraph 401-6.2d after correction for over 25% of the sublot shall be removed and replaced full depth of the surface lift at the Contractor’s expense.

Table 6. Price adjustment schedule[1]

Percentage of material within specification limits (PWL)	Lot pay factor (percent of contract unit price)
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject [2]

[1] Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project payment limitation specified in paragraph 401-8.1a.

[2] The lot shall be removed and replaced.

d. Profilograph Roughness. The Contractor will receive full payment when the profilograph average profile index is in accordance with paragraph 401-6.2e. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per 1/10 mile, payment will be made at the contract unit price for the completed pavement.

401-8.1 Payment.

Payment will be made under:

Item P-401-8.1 Asphalt Surface Course - per ton

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D979	Standard Practice for Sampling Asphalt Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Asphalt Paving Mixtures
ASTM D1188	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Asphalt Paving Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Asphalt Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures

ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5361	Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6084	Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM D6307	Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyratory Compactor.
ASTM D6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM D6995	Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations

ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
ASTM E950	Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference
ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
AASHTO T324	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures
AASHTO T 340	Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)

Asphalt Institute (AI)

Asphalt Institute Handbook MS-26, Asphalt Binder

Asphalt Institute MS-2 Mix Design Manual, 7th Edition

AI State Binder Specification Database

Federal Highway Administration (FHWA)

Long Term Pavement Performance Binder Program

Advisory Circulars (AC)

AC 150/5320-6 Airport Pavement Design and Evaluation

FAA Orders

5300.1 Modifications to Agency Airport Design, Construction, and Equipment Standards

Software

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SECTION P-401 PLANT MIX BITUMINOUS PAVEMENTS

DESCRIPTION

401-1.1 This Section consists of surface, leveling, and base courses composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with these Specifications and shall conform to the lines, grades, thicknesses, and typical cross sections shown on the Plans. Each course shall be constructed to the depth, typical section, or elevation required by the Plans and shall be rolled, finished, and approved before the placement of the next course.

401-1.2 RESPONSIBILITY. The Contractor shall be solely responsible for all work performed including preparation of Job Mix Formula, manufacture and placement of asphaltic concrete; and testing for quality control procedures necessary to assure compliance with all the requirements of this Section. A detailed description of the Contractor's Quality Control (CQC) requirements is included in Section 01440 of Division 1 "Contractor Quality Control Program" and in Appendix I of this Section.

The Architect/Engineer will be responsible to the County for all Quality Assurance (QA) requirements, including inspections, acceptance testing and all other duties of the Architect/Engineer described in this Section. The Architect/Engineer will direct the Project Testing Laboratory to perform certain of the duties assigned to the Architect/Engineer. The Contractor shall refer all matters requiring approval or technical interpretations to the Architect/Engineer, except for those certain specific matters wherein the Architect/Engineer has designated the Project Testing Laboratory as the operating agent of the Architect/Engineer.

401-1.3 TESTING AND INSPECTION. The Architect/Engineer and his authorized representative(s) shall have free access, at all times, to all parts of the paving plant(s), the Contractor's testing laboratory, the stockpiles, storage facilities, and other facilities and equipment employed by the Contractor in connection with the construction work under this Section in order for the Architect/Engineer to verify the Contractor's compliance with specification requirements.

The County will arrange for the Project Testing Laboratory to perform tests necessary to verify the Contractor's job mix formula, aggregates source(s), plant production and to perform acceptance testing for the work.

The Contractor shall perform all job mix formulae design, plant control, laydown control, compaction, coring and other quality control tests required by these Specifications.

The Contractor's testing laboratory shall be manned by an FDOT licensed technician(s), who shall also be thoroughly familiar with the Dade County Aviation Department testing requirements. Copies of the Contractor's technician's licenses shall be furnished to the Architect/ Engineer prior to the performance of any laboratory work at the Contractor's testing laboratory.

The Contractor shall perform all quality control tests in the Contractor's testing laboratory operated by the Contractor's FDOT certified technicians. All tests necessary for the County to confirm conformance with specification requirements prescribed herein for acceptance and payment purposes will be performed and reported independently by the Project Testing Laboratory. The Contractor shall witness the testing procedures of the Project Testing Laboratory and participate in these procedures to assure mutual agreement on test results. In like manner, the Project Testing Laboratory shall observe and participate in testing performed by the Contractor's testing technician(s). If mutual agreement as to test results is not achieved, both the Contractor and the Project Testing Laboratory shall report their results separately to the Architect/Engineer.

Acceptance of, and payment to Contractor for work performed under this Section, shall be based solely on the reports of the Project Testing Laboratory. The Architect/Engineer may conditionally accept work performed based on the Contractor's testing results and reports, but such conditional acceptance shall not prevent subsequent rejection of the material if the reports of the Project Testing Laboratory show that the work performed failed to meet Specifications requirements.

In addition to the testing requirements in these Specifications, the various Quality Control and Quality Assurance testing procedures shall be in accordance with the requirements of the Dade County Aviation Department as incorporated in these Specifications. It is mandatory that the Contractor follows all the test and quality control procedures established in these Specifications.

MATERIALS

401-2.1 AGGREGATE. Aggregates shall consist of crushed Miami Oolitic Limerock. The mineral aggregate shall be composed of materials obtained solely through the mining, crushing and manufacturing process. The portion of materials retained on the No. 8 (2.36 mm) sieve is coarse aggregate. The portion passing the No. 8 (2.36 mm) sieve and retained on the No. 200 (0.075 mm) sieve is fine aggregate, and the portion passing the No. 200 (0.075 mm) sieve is dust (mineral filler).

The addition or admixture of natural sand will not be permitted in any pavement mixture produced under these Specifications.

a. Coarse Aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from adherent films of matter that would prevent thorough coating and bonding with the bituminous material and be free from organic matter and other deleterious substances. The percentage of wear shall not be greater than 40 percent when tested in accordance with ASTM C 131. When tested in accordance with ASTM C88, the sodium sulfate soundness loss shall not exceed 9 percent after 5 cycles, and the magnesium sulfate soundness loss shall not exceed **12** percent, after 5 cycles.

Crushed aggregate shall contain at least 75 percent by weight of individual pieces having two or more fractured faces and 85 percent by weight having at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be obtained by artificial crushing.

The aggregate shall not contain more than 8 percent, by weight, of flat or elongated pieces, when tested in accordance with Appendix III E of the DCAD LPM.

A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.

b. Fine Aggregate. Fine aggregate shall consist of clean, sound, durable, angular particles produced by crushing Miami Oolitic limerock meeting the requirements for wear and soundness specified for coarse aggregates. The aggregate particles shall be free from coatings of marl/clay, silt, or other objectionable matter and shall contain no marl/clay balls or rock flour balls. The fine aggregate shall be non-plastic and its liquid limit shall be not more than 15 when tested in accordance with ASTM D 4318, as modified in DCAD T-611.

c. Sampling and Testing. ASTM D 75 shall be used in sampling coarse and fine aggregate. The Contractor shall furnish documentation to the Architect/Engineer confirming that the aggregates meet Specification requirements. The Contractor shall furnish aggregate samples to the Architect/Engineer for independent testing to verify compliance with the Requirements specified herein. Sampling of the aggregates will be observed and monitored by the Architect/ Engineer. No aggregate shall be used in the production of bituminous concrete mixtures without the Architect/Engineer's prior approval.

d. Sources of Aggregates. Aggregates shall be produced and supplied by a Florida DOT approved aggregate supplier(s) located in the Dade County area. Sources of aggregates shall be selected well in advance of the time the materials are required in the work. When the aggregates are obtained from a previously approved source or an existing source producing aggregates that has a satisfactory service record in airport bituminous pavement construction for at least 5 years, samples shall be submitted 30 days prior to start of production. When sources providing aggregates that have not been previously satisfactorily used for at least five (5) years on airport bituminous concrete pavement are proposed, the Contractor shall indicate the sources and shall submit samples and a plan for operation at least 60 days in advance of starting production. An inspection of the producer's operation will be made by the Architect/Engineer. Samples from test pits, borings, and other excavations shall be submitted at the same time. Approval of the source of aggregate does not relieve the Contractor in any way of the responsibility for delivery at the job site of aggregates that meet the requirements specified herein.

All aggregate delivery to the Contractor's bituminous mixing plant shall be accompanied by delivery tickets issued by the aggregate supplier. Aggregates shall be stored at the asphalt plant in separate designated stockpiles. The delivery tickets shall certify to the amount of the aggregates delivered and that the aggregates were obtained from the sampled and approved stockpile(s) source at the aggregate plant. Copies of these tickets shall be furnished to the Architect/Engineer, prior to the start of production and throughout the job production process.

e. Samples of Aggregates. Samples of aggregates shall be furnished by the Contractor at the start of production and at intervals during production of bituminous mixtures. The sampling points and intervals will be designated by the Architect/Engineer. The samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this Section.

401-2.2 THIS SUBSECTION NOT USED.

401-2.3 BITUMINOUS MATERIAL. Bituminous material shall be viscosity grade AC-30 conforming to the requirements of ASTM D 3381, as amended herein, with a mixing temperature not to exceed 325°F (162°C).

Silicone shall be added to the bituminous material at the rate of 25 cubic centimeters of silicone mixed into each 5,000 U.S. gallons (18,925 liters) of bituminous material. If a dispersing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cubic centimeters of silicone shall be added, in accordance with the manufacturers recommendations. The blending of silicone mixture with the bituminous material shall be done by the bituminous material producer prior to shipment. This is a mandatory statewide FDOT requirement.

The specified Viscosity Grade AC-30 Bituminous Material shall comply with the requirements of Tables 2 of ASTM D 3381 with the following modifications:

(MODIFICATIONS TO TABLE 2 OF ASTM D 3381)

Tests	VISCOSITY GRADE
	AC-30
Test on residue from thin-film oven tests:	
Viscosity Ratio $= \dfrac{\text{Visc. 140°F (60°C) after TFOT}}{\text{Visc. 140°F (60°C) before TFOT}}$	4 Max.
Loss on Heating, %	0.5 Max.
Ductility, 25°C (77°F), 5 cm/min.; cm	50 Min.

The Contractor shall furnish vendor's certified test reports for each tankload of bitumen shipped to the project. The reports shall be delivered to the Architect/Engineer before permission is granted for use of the material.

The vendor's certificate shall attest to the compliance with the specified requirements for the bituminous materials and with the above specified requirements for blending silicone in the bituminous material. The furnishing of the vendor's certified test reports for the bituminous material is prerequisite to final acceptance. The Contractor shall also furnish one gallon of the bituminous material proposed for use to the Architect/Engineer in conjunction with JMF aggregate samples, and one quart samples of the material from each carload or truckload of bitumen shipped to the project. The sampling shall be done under the supervision of the Architect/Engineer. The Contractor shall also furnish the Architect/Engineer with a current Temperature/Viscosity chart for the bituminous material supplied by the Vendor, in accordance with ASTM D 2493.

401-2.4 PRELIMINARY MATERIAL ACCEPTANCE. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Architect/Engineer for the following materials:

a. Coarse Aggregate.

(1) Percent of wear.

(2) Soundness.

(3) Unit weight of aggregate stockpile(s) per cubic foot (m^3).

b. Fine Aggregate.

(1) Liquid limit.

(2) Plastic index.

(3) Unit weight of aggregate stockpiles per cubic foot (m^3).

c. Bituminous Material - Vendor's certificate and current temperature/viscosity chart.

These certification(s) shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the Specification requirements.

The Architect/Engineer shall request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable Specifications.

COMPOSITION

401-3.1 COMPOSITION OF MIXTURE. The bituminous plant mix shall be composed of a mixture of well-graded aggregate, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

401-3.2 JOB MIX FORMULA. No bituminous mixture for payment shall be produced until a job mix formula(s) has been approved by the Architect/Engineer. The bituminous mixture shall be designed using procedures contained in Chapter III, MARSHALL METHOD OF MIX DESIGN, of the Asphalt Institute's Manual Series No. 2 (MS-2), Mix Design Methods for Asphalt Concrete as modified in this specification, and shall meet the requirements of Tables 1 and 2 of this Sub Article.

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in paragraph 401-5.2b. The criteria is based on a production process which has a material variability with the following standard deviations:

Stability in pounds (Newtons)	=	270 (1200)
Flow 0.01 inch (0.25 mm) units	=	1.5
Air Voids (%)	=	0.65

When material variability exceeds the standard deviations indicated, the job mix formula and subsequent production targets shall be based on a minimum stability greater than shown in Table 1, and the flow and air voids shall be targeted close to the mid-range of the criteria in order to meet the acceptance requirements.

If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867, is less than 75, the aggregates shall be rejected or the asphalt treated with an approved anti-stripping agent. The amount of anti-stripping agent added to the asphalt shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it will be provided by the Contractor at no additional cost.

If the Index of Retained Strength of the specimens of composite mixture, as determined by ASTM D-1075, is less than 75, the aggregates shall be rejected.

The job mix formula shall be submitted in writing by the Contractor to the Architect/Engineer at least 21 days prior to the start of paving operations and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Asphalt viscosity.

d. Number of blows of hammer compaction per side of molded specimen.

e. Mixing temperature.

f. Compaction temperature.

g. Temperature of mix when discharged from the mixer.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the Federal Highway Administration (FHWA) 45 power gradation curve.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight verses asphalt content.

k. Percent of aggregate from each stockpile.

l. Percent fractured faces.

m. Percent elongated particles.

n. Tensile Strength Ratio (TSR).

o. Index of Retained Strength.

p. Antistrip agent (if required).

q. All test data used to develop the job mix formula shall also be submitted.

The Contractor shall submit samples to the Architect/Engineer, upon request, for job mix formula verification testing.

The job mix formula for each mixture shall be in effect until modified by Contractor and approved in writing by the Architect/Engineer. Should a change in sources of materials be made, a new job mix formula must be approved by the Architect/Engineer before the new material is used.

The name of the laboratory or plant technician(s) proposed to be used by the Contractor in formulating the job mix and an accompanying certification that the proposed technician(s) is capable of performing all the tests required by these Specifications and a listing of the equipment available shall be submitted to the Architect/Engineer for approval.

TABLE 1. MARSHALL DESIGN CRITERIA

TEST PROPERTY	VALUES
Number of blows	75
Stability, pounds (newtons) minimum*	2150 (9555)
Flow, 0.01 in. (0.25mm)	9-14
Air voids (percent)	3-5
Temperature of Mixture Immediately prior to compaction	250°F±5°F (121°F ± 3°C)
Percent voids in mineral aggregate, minimum	See Table 2
Unit Weight	± 1.5 lbs.

* Due to variability of local Oolitic Limerock Aggregates a working minimum of 2,400 should be assumed for initial plant operations.

TABLE 2. MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE

Maximum Particle Size		Minimum Voids in Mineral Aggregate, percent
in.	**mm**	**Percent**
1/2	**12.5**	**16**
3/4	**19.0**	**15**
1	**25.0**	**14**

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory screens, will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM Standard C 136 and C 117. The "Washed Sieve Analysis (Aggregates)" procedure "B" (with wetting agent) contained in ASTM C-117 shall be used to determine the true dust (passing the No. 200 sieve) fraction in the aggregate.

The gradations in Table 3 represent the limits which shall determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the JMF), shall have a gradation within the limits designated in Table 3 and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be uniformly graded from coarse to fine.
The percentage by weight for the bituminous material shall be within the limits specified in Table 3 based on the results of absorption tests (Rice's Method)

performed in accordance with ASTM D 2041 and may, with the written approval of the Architect/Engineer, be increased 0.1% - 0.2% greater than that required for the job mix formula, based on the concurrent results of the bulk impregnated specific gravity tests performed in accordance with the Corps of Engineer's testing procedures Manual EM-1110-45-302, and further providing that the periodic retesting of the JMF maximum specific gravity (obtained in accordance with ASTM D 2041) provides results consistent with the original approved JMF test results.

Deviations from the final approved mix design for bitumen content and gradation of aggregates shall be within the action limits for individual measurements as specified in paragraph 401-6.5a. The limits still will apply if they fall outside the master grading band in Table 3.

The maximum size aggregate used shall not be more than one-half of the thickness of the course being constructed.

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute Manual Series No. 2 (MS-2), Appendix A, Par. A.09.

TABLE 3. AGGREGATE - BITUMINOUS PAVEMENTS
PERCENTAGE BY WEIGHT PASSING SIEVES

SIEVE SIZE	**1/2" (12.5mm)** NOMINAL MAX.	**3/4" (19.0mm)** NOMINAL MAX.	**1" (25.0mm)** NOMINAL MAX.
1 in. (25.0mm)	--	100	100
3/4 in. (19.0mm)	--	93 to 100	82 to 98
1/2 in. (12.5mm)	100	82 to 100	71 to 87
3/8 in. (9.5 mm)	79 to 99	72 to 90	62 to 78
No. 4 (4.75 mm)	56 to 74	54 to 71	47 to 63
No. 8 (2.36 mm)	43 to 61	42 to 59	35 to 51
No. 16 (1.18 mm)	32 to 50	32 to 48	27 to 43
No. 30 (0.60 mm)	23 to 40	22 to 38	22 to 38
No. 50 (0.30 mm)	15 to 30	14 to 28	15 to 28
No. 100 (0.15 mm)	8 to 20	7 to 17	7 to 16
No. 200 (0.075 mm)	2 to 6	2 to 6	2 to 6
Asphalt Percent:	6.5 to 8.5	6.5 to 8.5	6.5 to 8.0

401-3.2.1 The use of Recycled Asphalt Concrete Pavement (RAP) is not permitted.

401-3.3 TEST SECTION. Prior to full production, the Contractor shall prepare and place a quantity of bituminous mixture according to the job mix formula. The amount of mixture should be sufficient to construct a test section 100 to 300 feet long and 20 to 30 feet wide placed in two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. The location and extent of the test section shall be designated by the Architect/Engineer. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and procedure used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

Where two types of courses or two or more layers are involved, the top course shall not be placed until the lower course has cooled to nearly ambient temperature.

Three random samples shall be taken at the plant and tested for stability, flow, and air voids in accordance with paragraph 401-5.1a(2). Two random samples of mixture shall be taken at the plant and tested for aggregate gradation and asphalt content in accordance with paragraphs 401-6.3a and 401-6.3b and evaluated in accordance with paragraphs 401-6.5a and 401-6.5b. The first Marshall and extraction samples shall be taken upon the start of plant production. Three randomly selected cores shall be taken from the finished pavement mat, and three from the adjacent longitudinal joint, and tested in accordance with paragraph 401-5.1b(4). Random sampling shall be in accordance with procedures contained in ASTM D 3665 and as depicted in Section 8 of Appendix III.

Mat density and air voids shall be evaluated in accordance with paragraph 401-5.2f(1). Stability and flow shall be evaluated in accordance with paragraph 401-5.2f(2). Joint density shall be evaluated in accordance with paragraph 401-5.2f(3).

Voids in the mineral aggregate (VMA), for each plant sample, shall be computed in accordance with procedures contained in Chapter III, MARSHALL METHOD OF MIX DESIGN, of the Asphalt Institute's Manual Series No. 2 (MS-2), Mix Design Methods for Asphalt Concrete and as depicted in Section 2 of Appendix III.

The test section shall be considered acceptable if; 1) stability, flow, mat density, air voids, and joint density are 90 percent or more within limits, 2) gradation and asphalt content are within the action limits specified in paragraphs 401-6.5a and 5b, and 3) the voids in the mineral aggregate is within the limits of Table 2.

If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production for the Control Test Section shall not begin until acceptable trial test sections have been constructed and accepted by the Architect/Engineer in writing. The initial test section, whether acceptable or unacceptable, and any subsequent test section that meets specification requirements shall be paid for in accordance with paragraph 401-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the job mix formula. It should be recognized that the aggregates produced by the plant may not satisfy the gradation requirements or produce a mix that exactly meets the JMF. In those instances, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens should be prepared again and the optimum bitumen content determined in the same manner as for the original design tests.

401-3.4 CONTROL TEST SECTION. The Control Test Section shall serve to determine initial conformance of full-scale job production to Marshall Design Criteria and all other Specification requirements. When satisfactory bituminous mixture(s) has been developed, a full-scale Control Test Section shall be placed and evaluated. The location of the Control Test Section shall be designated by the Architect/ Engineer. It shall be identical to the pavement structure covered in this project. Plant operation shall start and a quantity of bituminous material not less than 600 tons, divided into three equal lots, shall be prepared, placed, and tested as specified herein. A minimum of four core samples per each lot of finished pavement shall be taken at equal intervals and tested in accordance with the Specifications. Should this Control Test Section not conform to all Specifications requirements, the Contractor shall not commence job production until such out-of-tolerance conditions have been remedied by the Contractor and approved in writing by the Architect/Engineer. If the Control Test Section fails to meet the requirements of the Specifications, the Architect/Engineer reserves the right to order the Contractor to perform additional Trial Test Section(s), in accordance with the requirements of 401-3.3 above, prior to performing the second Control Test Section. Marginal quality Control Test Sections may be left in place, when agreed in writing by the Contractor and the Architect/Engineer. Rejected Control Test Sections which are removed will not be paid for.

Accepted Control Test Sections meeting all of the requirements of this Section, and marginal quality Control Test Sections approved by the Architect/Engineer to remain in place, will be paid for in accordance with subarticle 401-5.2 "Acceptance Criteria" and Article 8.1 "BASIS OF PAYMENT".

401-3.5 TESTING LABORATORY. The Contractor and/or the asphaltic concrete mix producer, shall provide two plant testing laboratories at the job mix producing plant site for the performance of the specified project testing. One laboratory to be used by the Contractor testing laboratory and the other to be used by the Project Testing Laboratory or, at the Contractor's option subject to approval by the Architect/Engineer, provide one testing laboratory for the joint use by the Project Testing Laboratory and the Contractor's testing laboratory in accordance with the requirements of Appendix II to these Specifications.

The testing laboratory shall be utilized for job mix design, control and acceptance testing functions during periods of job mix formulation, production and testing. Each laboratory shall include adequate equipment, space, air conditioning and utilities as required for the performance of the specified tests set forth in these Specifications.

The testing laboratory used to develop the job mix formula shall be a Florida DOT approved laboratory meeting the requirements of Appendix II to these Specifications and the requirements of ASTM D 3666. The Contractor shall provide a written certification signed by the manager of the laboratory that it meets or exceeds all the requirements of these Specifications and is equipped to perform all the tests required by these Specifications prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising Florida State certified technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix design and utilized for control and acceptance testing functions during periods of job mix formulation, production and testing.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

The Project Testing Laboratory will inspect the Contractor's testing facilities to determine its compliance with these requirements, and will certify to the Architect/Engineer when the Contractor's testing laboratory meets all the Contract requirements. The Contractor shall not perform any laboratory design or testing until the certification issued by the Project Testing Laboratory has been reviewed and approved, in writing by the Architect/Engineer, for use under this Contract.

401-3.6 ADDITIONAL JOB MIX FORMULA. If more than one bituminous mixing plant is to supply material under the Contract, the applicable requirements of Articles of these Specifications and referenced Standard Specifications shall apply to each additional plant. A separate JMF shall be developed for each bituminous mixing plant and each plant shall be equipped with its own testing laboratory and Florida State certified technician.

Bituminous concrete mixture from more than one plant shall not be placed simultaneously by the same asphalt paving operation in the field. The Contractor shall provide a separate paving operation in the field to handle each plant's production.

CONSTRUCTION METHODS

401-4.1 WEATHER LIMITATIONS. The bituminous mixture shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived when approved in writing by the Architect/Engineer; however, all other requirements including compaction shall be met.

TABLE 4. BASE TEMPERATURE LIMITATIONS

Mat Thickness	Base Temperature (Min.)	
	Deg. F	Deg. C
3 in. (7.5 cm) or greater	40	4
Greater than 1 1/2 in. (37.5 mm) but less than 3 in. (75 mm)	45	7
1 1/2 in. (37.5 mm) or less	50	10

The underlying surfaces upon which the bituminous concrete mixture is to be placed may be surface damp (i.e., saturated surface dry condition), but no free water shall be present on the surface to be paved, subject to approval by the Architect/Engineer.

401-4.2 BITUMINOUS MIXING PLANT. Plants used for the preparation of bituminous mixtures shall be FDOT approved facilities and shall conform to the requirements of ASTM D 995 with the following changes:

In case of conflict between the requirements of ASTM D 995 and these Technical Specifications, the requirements of these Technical Specifications shall govern.

The different aggregate sizes shall be kept separate until they have been delivered to the cold elevator or cold bins feeding the drier or the drum mixer. The storage yard shall be neat and orderly, and the separate stockpiles shall be readily accessible for sampling.

The use of more than one plant shall not be permitted unless specifically authorized by the Architect/Engineer in writing after evaluation of the compatibility of the various asphaltic concrete mixes on the job site. The plant shall be equipped with operational controls and recording devices.

a. Requirements for All Plants.

(1) Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense unless an automated plant with automatic printers is used. Scales shall be inspected and sealed as often as the Architect/Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of Section 01750 of Division 1 of the Contract Documents.

(2) Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Architect/Engineer's acceptance testing and the Contractor's quality control testing, in accordance with paragraphs 401-3.5 and 401-6.2.

(3) Inspection of Plant. The Architect/Engineer, or its authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

(4) Storage Bins and Surge Bins. Paragraph 3.9 of ASTM D 995 is deleted. Instead, the following applies. Use of surge bins or storage bins for temporary storage of hot bituminous mixtures will be permitted as follows:

(a) The bituminous mixture may be stored in surge bins for period of time not to exceed 3 hours.

(b) The bituminous mixture may be stored in insulated storage bins for a period of time not to exceed 24 hours, provided an inert gas atmosphere is maintained in the bin during the storage period.

The bins shall be such that mix drawn from them meets the same requirements as mix loaded directly into trucks.

If the Architect/Engineer determines that there is an excessive amount of heat loss, segregation or oxidation of the mixture due to temporary storage, no overnight storage will be allowed.

(5) The following are additional supplements to ASTM D 995, as applicable to the work under this Contract.

(a) Requirements for All Plants. Modify Article 3 of ASTM D 995 by adding the following:

Thermometric Equipment. The Contractor shall replace the thermometer with an approved temperature-recording apparatus if in the opinion of the Architect/Engineer, replacement is necessary for proper regulation of the temperature of the aggregates.

Emission Controls. All dust material collected shall be wasted. Under no circumstances shall any dust, that either escaped or was collected by any collection system, be reintroduced into the hot elevator or the hot mineral aggregates or any other place in the plant operating system.

Cold Aggregate Feeder. An automatic plant shutoff shall be provided to operate when any aggregate bin becomes empty.

Safety Requirements. Adequate and safe stairways to the mixer platform and sampling points shall be provided, and guarded ladders to other plant units shall be placed at all points where accessibility to plant operation is required. Accessibility to the top of truck bodies shall be provided by a suitable device to enable the Architect/Engineer, or the Project Testing Laboratory technician, to obtain sampling and mixture temperature data.

Means shall be provided to raise and lower scale calibration equipment, sampling equipment, and other similar equipment between the ground and mixer platform.

(b) Requirements for Plants Controlling Gradation of Hot, Dry Aggregates. Modify Article 4.2 of ASTM D 995 by adding the following:

Hot Aggregate Bins. The plant shall include storage bins of sufficient capacity to supply a mixer operating at full capacity. The gates shall cut off quickly and completely, or provide suitable continuous feed on a drum-mix plant.

(c) Requirements for Batch Plants. Modify Article 6 of ASTM D 995 by adding the following:

Bituminous Control. Steam jackets, if used, shall be sufficiently drained, and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous material scales. The capacity of the bituminous material bucket shall be at least 15 percent in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated, quick-acting, nondrip charging valve located directly over the bituminous material bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of bituminous material used per batch. The controls shall be constructed to lock at any dial setting and automatically reset to that reading after the addition of the bituminous material to each batch of the bituminous concrete mixture.

The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled to begin when the dry mixing period is over. All of the bituminous material required for one batch shall be discharged in not more than 15 seconds after the flow has begun. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and the spray bar shall have a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

Mixer. The batch plant mixer shall be an approved type capable of producing a uniform mixture within the job mix tolerances. The clearance of blades from all fixed and moving parts shall not exceed one inch.

Control of Mixing Time. The timing control shall be flexible and shall be capable of settings of 5-second intervals or less throughout a 3-minute cycle. A mechanical batch counter shall be installed as a part of the timing device and shall be designed to register only completely mixed batches. The case covering the timing device shall be locked until a change is made in the timing periods.

Recording of Batching. The use of automatic graphic or digital record in accordance with Article 6.8.1 of ASTM D 995, is required.

(d) Requirements for Continuous Mix Plants. Modify Article 7 of ASTM D 995 by adding the following:

Weight Calibration of Aggregate Feed. The plant shall be equipped to conveniently permit the procurement of individual test samples of not less than 200 pounds (91Kg). Accurate scales shall be provided by the Contractor to weigh such test samples.

Synchronization of Aggregate Feed and Bituminous Material Feed. The synchronization of aggregate feed and bituminous material feed control shall be made by interlocking mechanical means as specified in ASTM D 995 or by any other positive method approved by the Architect/Engineer.

(e) Requirements for Drum - Mix Plants. Modify Paragraph 8.2.2 of ASTM D 995 by adding the following:

The plant shall be equipped with sensors to automatically determine the moisture contents of aggregates and to automatically adjust the proportions of materials on a continual basis.

401-4.3 HAULING EQUIPMENT. Trucks used for hauling bituminous mixtures shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

401-4.4 BITUMINOUS PAVERS. Bituminous pavers shall be self-propelled, with an activated screen integrally heated, and shall be capable spreading and finishing courses of bituminous plant mix material which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required smoothness, evenness, texture and density without tearing, shoving, rippling or gouging the mixture.

Automatic grade control devices shall be used, and the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screen at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls shall be capable of working on both sides of the paver simultaneously in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet (9.14m) in length or as directed by the Architect/Engineer.

b. Taut stringline (wire) set to grade.

c. Short ski or shoe.

d. Laser control with continuous survey monitoring.

401-4.5 ROLLERS. Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

The use of equipment which causes excessive crushing of the aggregate will not be permitted.

401-4.6 PREPARATION OF BITUMINOUS MATERIAL. The bituminous material shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of the bituminous material delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325 degrees F (160 degrees C).

401-4.7 PREPARATION OF MINERAL AGGREGATE. The aggregate for the mixture shall be heated and dried prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the limerock aggregates. The temperature of the aggregate shall not exceed 350 degrees F (175 degrees C) when the asphalt is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to thoroughly dry the mineral aggregate and to obtain a complete coating of bituminous material with uniform distribution on the aggregate particles and to further provide a mixture of satisfactory workability.

401-4.8 PREPARATION OF BITUMINOUS MIXTURE. The aggregates and the bituminous material shall be weighed or metered and introduced into the mixer in the amount specified by the job mix formula, after making proper corrections for moisture content of the aggregates.

The combined materials shall be mixed until the aggregate obtains a uniform coating of bitumen and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 30 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant, for each type of aggregate used based on sound engineering evaluation of facilities available. The wet mixing time will be set to achieve not less than 95 percent of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all bituminous mix upon discharge shall not exceed 0.5 percent. Water in the aggregate shall be removed by heating to the extent that there are no visible signs of subsequent foaming in the mixture prior to the placing of the material in the field.

The Contractor shall observe distribution of aggregate and bituminous material entering the pugmill, speed of mixer shafts, arrangements, pitch and wear of paddles to determine the mixing rate efficiency. Mixing time shall be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with bituminous material. The Contractor shall not change the mixing time without the prior written approval of the Architect/Engineer.

401-4.9 PREPARATION OF THE UNDERLYING SURFACE. Immediately before placing the bituminous mixture, the underlying course shall be cleaned of all dust and debris with vacuum, power blowers, power and hand brooms as directed by the Architect/Engineer. A prime coat and bituminous surface treatment or tack coat shall be applied in accordance with Section P-602 and P-609, or P-603, as required by the Contract Specifications.

401-4.10 TRANSPORTING, PLACING, AND FINISHING. The bituminous mixture shall be transported from the mixing plant to the site in vehicles conforming to the requirements of paragraph 401-3. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. The Contractor may elect to use a separate material transfer vehicle to deliver mix continuously to the paver in the field. Adequate artificial lighting shall be provided for night placements and approved by the Architect/Engineer. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature. No bituminous mixture shall be placed over a previously placed mixture until the latter has been tested and approved by the Architect/Engineer.

No bituminous mixture shall be placed over tacked surfaces or bituminous surface treatment until such surfaces are cured in accordance with Section P-603 or P-609.

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250 degrees F (121 degrees C).

Upon arrival, the mixture shall be placed to the full width by an approved bituminous paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated on the Plans. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise approved by Architect/Engineer, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 12 feet (3.6 m) except where edge lanes require less width to complete the area. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by one-half the width of the layer being placed; however, the joint in the surface top course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 25 feet (7.62 m) from transverse joints in the previous course.

Transverse joints in adjacent lanes shall be offset a minimum of 50 feet (15.25m) where practicable.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools provided that the finished surface has the same texture as the adjacent machine spread and machine finished surface.

401-4.11 COMPACTION OF MIXTURE. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. Rolling shall be initiated with the drive wheel toward the paving machine. The sequence of rolling operations and the type of rollers used shall be similar to those established during the construction of the accepted Control Test Section as per 401-3.4.

The speed of the roller shall, at all times, be sufficiently slow to avoid displacement, cracking or shoving of the hot mixture and be effective in compaction. Any displacement, cracking or shoving occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until all roller marks are eliminated, the surface is of uniform texture, true to grade and cross section, and the required field density is obtained.

To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened (and scrapers used), but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers.

Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed. The Contractor shall sawcut and remove the top layer of the pavement within the affected area (limits of removal will be as ordered by the Architect/Engineer) and replace the pavement to proper grade.

401-4.12 JOINTS. The Contractor shall develop and provide the Architect/ Engineer with a paving laydown plan which will minimize the number of cold joints in the pavement, and align the paving lanes with the primary direction of aircraft movements. The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods all contact surfaces shall be given a tack coat of bituminous material before placing any fresh mixture against the joint.

Longitudinal joints which are irregular, damaged, uncompacted, or otherwise defective shall be cut back to expose a clean, sound surface for the full depth of the course using approved mechanical saws or a milling machine. The joint shall be placed so that it will be horizontally separated from that in the base, leveling or existing surface course by at least three (3) feet (0.90m). All contact surfaces shall be given a tack coat of bituminous material prior to placing any fresh mixture against the joint.

MATERIAL ACCEPTANCE

401-5.1 ACCEPTANCE SAMPLING AND TESTING. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this Section will be performed by the Project Testing Laboratory at no cost to the Contractor. The Testing organization performing these tests shall meet the requirements of ASTM D 3666. All equipment in Contractor furnished laboratories shall be calibrated by the testing organization prior to the start of operations.

a. Plant-Produced Material. Plant-produced material shall be tested for stability, flow, and air voids on a lot basis. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. A lot will consist of:

- o one day's production where a day's production is not expected to exceed 2,000 tons (1800 metric tons), or
- o a half day's production where a day's production is expected to consist of between 2,000 and 4,000 tons (1800 and 3600 metric tons), or
- o similar subdivisions for tonnages over 4,000 tons (3600 metric tons).

Where more than one plant is simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

(1) Sampling. Each lot will consist of four equal sublots. Sufficient material for preparation of test specimens will be sampled by the Architect/Engineer on a random basis, in accordance with the procedures contained in ASTM D 3665. One set of laboratory compacted specimens will be prepared for each sublot in accordance with ASTM D 1559, paragraph 4.5, at the number of blows required by paragraph 401-3.2, Table 1. Each set of laboratory compacted specimens will consist of not less than four test portions prepared from the same sample increment.

The sample of bituminous mixture may be put in a covered metal tin and placed in an oven for not more than 30 minutes to maintain the heat. The compaction temperature of the specimens shall be as specified in Table 1.

(2) Testing. Sample specimens shall be tested for stability and flow in accordance with ASTM D 1559, paragraph 4. Air voids will be determined by the Architect/Engineer in accordance with ASTM D 3203.

Prior to testing, the bulk specific gravity of each test specimen shall be measured by the Architect/Engineer in accordance with ASTM D 2726 for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture shall be measured for each sublot and a minimum of three times for each short lot in accordance with ASTM D 2041, Type D container using a minimum sample size of 2000 gm. Samples shall be taken on a random basis in accordance with ASTM D 3665. The value used in the voids computation for each sublot shall be the average of the maximum specific gravity measurements taken for the lot. However, when significant test variations occur in the various sublot specific gravity measurements then the respective individual test values shall be used for each sublot voids computation when directed by the Architect/Engineer.

The stability, flow, and air voids for each sublot shall be computed by averaging the results of the three or four test specimens representing that sublot.

(3) Acceptance. Acceptance of plant produced material for stability, flow, and air voids shall be determined by the Architect/Engineer in accordance with the requirements of paragraph 401-5.2b.

b. Field Placed Material. Material placed in the field shall be tested for mat and joint density on a lot basis.

(1) Mat Density. The lot size shall be the same as that indicated in paragraph 401-5.1.a and shall be divided into three or four equal sublots. One or more cores of finished, compacted materials shall be taken by the Contractor from each sublot. Core locations will be determined by the Architect/Engineer on a random basis in accordance with procedures contained in ASTM D 3665 and as modified in Section 8 of Appendix III. Cores shall not be taken closer than one foot (30 cm) from a transverse or longitudinal joint.

(2) Joint Density. The lot size shall be the total length of longitudinal joints constructed by a lot of material as defined in paragraph 401-5.1a. The lot shall be divided into three or four equal sublots. One or more cores of finished, compacted materials shall be taken by the Contractor from each sublot. Core locations will be determined by the Architect/Engineer on a random basis in accordance with procedures contained in ASTM D 3665.

(3) Sampling. Samples shall be neatly cut with a core drill. The cutting edge of the core drill bit shall be of hardened steel with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be six inches. Samples that are clearly defective, as determined by the Architect/Engineer as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples and filling the cored pavement. Cored holes shall be filled and compacted in a manner acceptable to the Architect/Engineer and within one day after sampling.

(4) Testing. The bulk specific gravity of each cored sample will be measured by the Architect/Engineer in accordance with ASTM D 2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, unless directed to use sublot basis by the Architect/Engineer, as determined in paragraph 401-5.1a(2).

(5) Acceptance. Acceptance of field placed material for mat density will be determined by the Architect/Engineer in accordance with the requirements of paragraph 401-5.2c. Acceptance for joint density will be determined in accordance with the requirements of paragraph 401-5.2d.

c. Partial Lots - Plant-Produced Material. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch or truck load produced where production is unexpectedly halted will be sampled and its properties shall be considered as representative of the particular sublot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot or the previous lot, and the total number of sublots shall be used in the acceptance plan calculation, i.e., n = 5 or n = 6, for example.

d. **Partial Lots - Field Placed Material.** The lot size for field placed material shall correspond to that of the plant material, except that in no case shall less than (3) cored samples be obtained, i.e., n = 3.

401-5.2 ACCEPTANCE CRITERIA.

a. **General.** Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement, as well as the implementation of the Contractor's Quality Control plan and test results:

(1) Stability
(2) Flow
(3) Air voids
(4) Mat density
(5) Joint density
(6) Thickness
(7) Smoothness
(8) Grade

Stability, flow, and air voids will be evaluated for acceptance in accordance with paragraph 401-5.2b. Mat density will be evaluated for acceptance in accordance with paragraph 401-5.2c. Joint density will be evaluated for acceptance in accordance with paragraph 401-5.2d.

Acceptance for mat density and air voids will be based on the criteria contained in paragraph 401-5.2f(1). Acceptance for stability and flow will be based on the criteria contained in paragraph 401-5.2f(2). Acceptance for joint density will be based on the criteria contained in paragraph 401-5f(3). Thickness will be evaluated by the Architect/Engineer for compliance in accordance with paragraph 401-5.2.f(4). Acceptance for smoothness will be based on the criteria contained in paragraph 401-5.2f(5). Acceptance for grade will be based on the criteria contained in paragraph 401-5.2f(6).

The Architect/Engineer may at any time, not withstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of bituminous mixture which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, improper mix temperature or excess moisture present in mix materials. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, except in the case of visually observed moisture, the Contractor may take a representative sample of the rejected material in the presence of the Architect/Engineer. Then if it can be demonstrated in the laboratory, in the presence of the Architect/Engineer, that such material was erroneously rejected, payment will be made for the material at the Contract Unit Price.

b. **Stability, Flow, Air Voids.** Acceptance of each lot of plant produced material for stability, flow, and air voids shall be based on the percentage of material within specification limits (PWL). The PWL plan considers the variability (standard deviation) of the material and the testing procedures, as well as the average (mean) value of the test results. If a material with high variability is produced, the production target must be adjusted as outlined in paragraph 401-3.2 to achieve a PWL of 90 or more.

c. Mat Density. Acceptance of each lot of in-place pavement for mat density shall be based on the percentage of material within specification limits (PWL). If a material with high variability is produced, then a higher target density must be maintained in order to achieve a PWL of 90 or more.

d. Joint Density. Acceptance of each lot of in-place pavement for joint density shall be based on the percentage of material within specification limits (PWL). If a material with high variability is produced, then a higher target density must be maintained in order to achieve a PWL of 90 or more.

e. Percentage of Material Within Specification Limits (PWL). The percentage of material within specification limits (PWL) shall be determined in accordance with procedures specified in Section 01426 of Division 1. The specification tolerance limits(L) and (U) are contained in Table 5 of P-401-5.2.

f. Acceptance Criteria.

(1) Mat Density and Air Voids. If the PWL of the lot equals or exceeds 90 percent, the lot shall be acceptable. If the PWL is less than 90 percent, payment shall be made in accordance with paragraph 401-8.1a.

(2) Stability and Flow. If the PWL of the lot equals or exceeds 90 percent, the lot shall be acceptable. If the PWL is less than 90 percent, the Contractor shall determine the reason and take corrective action. If the PWL is below 80 percent, the Contractor must stop production and make adjustments to the mix.

(3) Joint Density. If the PWL of the lot equals or exceeds 90 percent, the lot shall be acceptable. If the PWL is less than 90 percent, the Contractor shall evaluate the method of compacting joints. If the PWL is below 80 percent, the Contractor shall stop production until the reason for poor compaction can be determined.

(4) Thickness. Thickness shall be evaluated for compliance by the Architect/Engineer to the minimum requirements shown on the Plans. Measurements of thickness shall be made by the Architect/Engineer using the cores extracted for each sublot for density measurement and any additional cores taken at specific locations when directed by the Architect/Engineer.

(5) Smoothness. The finished surfaces of the pavement shall not vary more than 1/4 (6.2mm) inch for the surface and 3/8 (9.5mm) inch for the base course. Each lot shall be evaluated with a 12-foot (3.6m) straightedge or a standard 10 foot (3.0m) FDOT straight edge. The lot size shall be 1500 to 2000 square yards (1250 to 1650 square meters) based on the field placed pavement lot size. Measurements will be made perpendicular and parallel to the centerline at distances not to exceed 50 feet (15.0m). When more than 15 percent of all measurements within a lot exceed the specified tolerance, the Contractor shall remove the deficient area and replace with new material. Sufficient material shall be removed by milling to allow not less than 1 1/2 inches (37.5mm) of asphalt concrete to be placed. Skin patching shall not be permitted. High points may be ground off subject to approval by the Architect/Engineer.

(6) Grade. The finished surface of the pavement shall not vary from the gradeline elevations and cross sections shown on the Plans by more than 1/2 inch (12.5mm). The finished grade of each lot will be determined by running levels at intervals of 50 feet (15.0m) or less longitudinally and transversely to determine the elevation of the completed pavement. The lot size shall be the same as used for (5) smoothness in square yards (square meters). When more than 15 percent of all the measurements within a lot are outside the specified tolerance, the Contractor shall remove the deficient area and replace with new material. Sufficient material shall be removed to allow not less than 1 1/2 (37.5mm) inches of asphalt concrete to be placed. Skin patching for correcting low areas shall not be permitted. When more the 15% of all measurements within a lot are outside the specified tolerance, the Contractor may request that the levels be rerun at intervals of 25 feet (7.5m) and the percentage recalculated to determine if the finished surface smoothness still exceeds the specified tolerance requirement. If it does not, then the Lot shall be accepted for Grade and allowed to remain in place.

TABLE 5. ACCEPTANCE LIMITS STABILITY, FLOW, AIR VOIDS, DENSITY

Pavements Designed for Aircraft Gross Weights of 60,000 Lbs. (27,200 kgs) or More or Tire Pressure Greater Than 100 PSI (690 Pa)		
Test Property		
Number of Blows	75	
	Specification Tolerance	
	L	U
Stability, minimum pounds (Newtons)	1800 (8000)	-
Flow, 0.01-inch (0.25 mm)	8	16
Air voids total mix, percent	2.0	5.0
Mat density, percent	96.3	-
Joint density, percent	93.3	-

401-5.3 RESAMPLING PAVEMENT.

a. General. Resampling of a lot or sublot of pavement for mat density will be allowed if the Contractor requests, in writing, within 48 hours after receiving the written test results from the Architect/Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 401-5.1b and 401-5.2c. Only one resampling per lot will be permitted unless sample cores, in the opinion of the Architect/Engineer, are visibly damaged or are determined to be Outliers.

(1) A redefined PWL shall be calculated for the resampled lot. The number of tests used to calculate the redefined PWL shall include the initial tests made for that lot plus the retests. Cores less than 1 1/2 inches in thickness and cores that are clearly defective shall be discarded and another sample taken.

(2) The cost for resampling and retesting shall be borne by the Contractor.

b. Payment for Resampled Lots. The redefined PWL for a resampled lot shall be used to calculate the payment for that lot in accordance with Table 6.

c. Outliers. If the tests within a lot include a very large or a very small value which appears to be outside the normal limits of variation, check for an outlier in accordance with ASTM E 178, at a significance level of 5 percent, to determine if this value should be discarded when computing the PWL.

401-5.4 LEVELING COURSE. Any course used for truing and leveling shall meet the requirements of paragraph 401-3.2 and 5.2b, but shall not be subject to the density requirements of paragraph 401-5.2c and 401-5.2d. The leveling course shall be compacted with the same effort used to achieve density of the control test section. The truing and leveling courses shall not exceed a nominal or average thickness of 1-1/2 inches (37.5 mm). Random areas requiring greater than 3 inches (75 mm) of leveling course shall be placed in two or more lifts. Extensive areas of the pavement requiring a truing and leveling course shall be shown on the Plans.

CONTRACTOR QUALITY CONTROL

401-6.1 GENERAL. The Contractor shall develop a Quality Control Program in accordance with Section 01440 of Division 1 and Appendix I to these Specifications. The program shall address all elements which affect the quality of the pavement including, but not limited to:

- **a.** Mix Design
- **b.** Aggregate Grading
- **c.** Quality of Materials
- **d.** Stockpile Management
- **e.** Proportioning
- **f.** Mixing and Transportation
- **g.** Placing and Finishing
- **h.** Mat and Joints
- **i.** Compaction
- **j.** Surface smoothness
- **k.** Finished grade

401-6.2 TESTING LABORATORY. The Contractor shall provide a fully equipped asphalt laboratory located at the plant. It shall be available for joint use by the Contractor for quality control testing and by the Architect/Engineer for acceptance testing and must have adequate equipment for the performance of the tests required by these Specifications. The Architect/Engineer shall have priority in use of the equipment necessary for acceptance testing.

The effective working area of the laboratory available to the Architect/Engineer shall be a minimum of 300 square feet (28 square meters) with a ceiling height of not less than 7.5 feet (2.3 meters). Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 70 degrees F + 5 degrees (21 degrees C + 2.3 degrees C). (See further detailed requirements in Appendix II to this Specification.)

Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Architect/Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility and witness quality control activities. The Architect/Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

401-6.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the Quality Control Program in accordance with procedures specified in Section 01440 of Division 1 and as further detailed in Appendix II to P-401. The testing program shall include, but not necessarily limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, thickness, and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

a. Asphalt Content. A minimum of one extraction test shall be performed per sublot in accordance with ASTM D 2172 for verification of asphalt content. The weight of ash portion of the extraction test, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part the first daily extraction test performed thereafter, for the duration of plant production. The current sublot weight of ash value obtained shall be used in the verification calculation of the asphalt content for the mixture.

The use of the nuclear method for determining the preliminary asphalt content in accordance with ASTM D 4125 is permitted, provided that it is calibrated for the specific mix being used and checked for accuracy by the subsequent sublot extraction test.

b. Gradation. Aggregate gradations shall be determined a minimum of once per sublot from mechanical analysis of extracted aggregate in accordance with AASHTO T 30 and ASTM C 136 (dry sieve) with ASTM C-117 washed sieve analysis Procedure "B" (with wetting agent). Aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix or continuous mix plants at the start of production for each sublot, and tested in accordance with ASTM C 136 (dry sieve) and ASTM C-117 (washed sieve) using actual batch weights to determine the combined aggregate gradation of the mixture.

c. Moisture Content of Aggregate. The moisture content of aggregate used for production shall be determined a minimum of once per sublot and whenever directed by the Architect/Engineer, in accordance with ASTM C 566.

d. Moisture Content of Mixture. The moisture content of the mixture in the pan used for the Marshall Testing shall be determined once per sublot in accordance with ASTM C566 as modified in Appendix III, but maintaining an even temperature of 250 $\pm$ 5°F for 30 minutes or until the mixture in the pan reaches a constant weight.

e. Temperatures. Temperatures shall be checked, at least once per sublot, at necessary locations to determine the temperatures of the dryer, the bitumen in the storage tank, the mixture at the plant, and the mixture at the job site.

f. In-Place Density Monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge shall be used to monitor the pavement density in accordance with ASTM D 2950.

g. Additional Testing. Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor's option.

h. Monitoring. The Architect/Engineer reserves the right to monitor any or all of the above testing.

401-6.4 SAMPLING. When directed by the Architect/Engineer, the Contractor shall sample and test any material which appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified in this Specification.

401-6.5 CONTROL CHARTS. The Contractor shall maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation, asphalt content, mat and joint density.

Control charts shall be posted in a location satisfactory to the Architect/Engineer and shall be kept current. As a minimum, the control charts shall identify the Project Number, the Contract Item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Architect/Engineer may suspend production or acceptance of the material.

a. Individual Measurements. Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, temperature of mix, mat and joint density. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS

SIEVE	1/2 Inch Nominal		3/4 Inch Nominal		1 Inch Nominal	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit	Action Limit	Suspension Limit
1 Inch (25.0 mm)	0%	0%	0%	0%	0%	0%
3/4 Inch (19.0 mm)	0%	0%	0%	0%	±7%	±12%
1/2 Inch (12.5 mm)	0%	0%	±6%	±9%	±6%	±9%
3/8 Inch (9.5 mm)	±6%	±9%	±6%	±9%	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%	±6%	±9%	±6%	±9%
No. 16	±5%	±7.5%	±5%	±7.5%	±5%	±7.5%
No. 50	±3%	±4.5%	±3%	±4.5%	±3%	±4.5%
No. 200	±2%	±3%	±2%	±3%	±2%	±3%
Asphalt Content*	±0.15%	±0.25%	±0.15%	±0.25%	±0.15%	±0.25%
Temperature of Mix	±13% (7°C)	±20°F (11°C)	±13°F (7°C)	±20°F (11°C)	±13°F (7°C)	±20°F (11°C)

* Minimum 10 batches or one truck load as determined from production tickets.

b. Range. Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified as follows are based on a sample size of n = 2. Since the Contractor must perform one test per sublot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

CONTROL CHART LIMITS BASED ON RANGE
(Based on n = 2)

SIEVE	1/2 Inch Nominal	3/4 Inch Nominal	1 Inch Nominal
	Suspension Limit	**Suspension Limit**	**Suspension Limit**
3/4 Inch (19.0 mm)	0%	0%	15%
1/2 Inch (12.5 mm)	0%	11%	11%
3/8 Inch (9.5 mm)	11%	11%	11%
No. 4 (4.75 mm)	11%	11%	11%
No. 16 (1.18 mm)	9%	9%	9%
No. 50 (0.30 mm)	6%	6%	6%
No. 200 (0.075 mm)	3.5%	3.5%	3.5%
Asphalt Content*	0.3%	0.3%	0.3%
Temperature of Mix	25°F (14°C)	25°F (14°C)	25°F (14°C)

* Minimum of 10 batches or one truck load as determined from production tickets.

c. **Corrective Action.** The Quality Control Plan shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

METHOD OF MEASUREMENT

401-7.1 MEASUREMENT. Plant mix bituminous concrete pavement shall be measured by the number of tons (kg) of bituminous mixture and the number of tons (kg) or U.S. gallons (liters) of bituminous material used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the quantities. The weight of bituminous material shall be adjusted in accordance with the percentage of bitumen as determined in paragraph 401-6.3a, unless Automated Plant weight recording printouts are available. When available such weights for bituminous material will be converted to U.S. gallons using the conversion factor of 8.5 pounds per gallon.

BASIS OF PAYMENT

401-8.1 PAYMENT. Payment for an accepted lot of bituminous concrete pavement shall be made at the contract unit price per ton (kg) for bituminous mixture and per ton (kg) or per U.S. gallon (liter) for bituminous material adjusted according to paragraph 401-8.1a. The price shall be full compensation for furnishing all materials, for all preparation, mixing, testing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

a. Basis of Adjusted Payment. Each lot shall be accepted at the full contract price when the percent within limits (PWL) for mat density and air voids equals or exceeds 90 percent. Method of estimating percentage of materials within Specifications (PWL) shall be in accordance with Section 01426 of Division 1. Each lot not meeting the 90 percent PWL requirement will be accepted at an adjusted contract unit price in accordance with Table 6. Payment shall be calculated for both mat density and air voids, and payment shall be based on the lower of the two values. The price adjustment shall apply to both the bituminous course and the bituminous material.

TABLE 6. PRICE ADJUSTMENT SCHEDULE

Percentage of Material Within the Specification Limit (PWL)	Percent of Contract Unit Price to be Paid
90-100	100
80-90	0.5 PWL + 55.0
65-80	2.0 PWL - 65.0
Below 65	(See Note [1])

[1] The lot shall be removed and replaced. However, the Architect/Engineer may decide to accept the deficient lot. In that case, if the Architect/Engineer and Contractor agree in writing, that the lot shall not be removed, then it will be paid for at 50 percent of the Contract Price.

b. Payment. Payment will be made under:

Item P-401-8.1a	Bituminous Surface, Leveling or Base Course--per ton (kg)
Item P-401-8.1b	Bituminous Material-- per ton (kg) or per U.S. gallon (liter)

TESTING AND MATERIAL REQUIREMENTS

ASTM C 29	Unit Weight and Voids in of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Test Method for Materials Finer than 75-um (No.200) Sieve in Mineral Aggregates by Washing
ASTM C 127	Specify Gravity and Absorption of Coarse Aggregates
ASTM C-128	Specific Gravity and Absorption of Fine Aggregates
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 566	Total Moisture Content of Aggregate by Drying
ASTM D 75	Sampling Aggregates
ASTM D 979	Sampling Bituminous Paving Mixtures
ASTM D 995	Requirements for Mixing Plants for Hot-Mixed Hot-Laid Bituminous Paving Mixtures
ASTM D 1075 (USCE Modified)	Effect of Water on Cohesion of Compacted Bituminous Mixtures.
ASTM D 1461	Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (Modified by AASHTO T-245)
ASTM D 2041	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures (Asphalt Absorption - Rice's Method)
ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2489	Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2493	Viscosity - Temperature Chart for Asphalt
ASTM D 2726	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
ASTM D 2950	Density of Bituminous Concrete in Place by Nuclear Method

ASTM D 3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3665	Random Sampling of Paving Materials
ASTM D 3666	Inspection and Testing Agencies for Bituminous Paving Materials
ASTM D 4125	Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Modified in DCAD Specification Test Section T-611)
ASTM D 4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM E 178	Practice for Dealing With Outlying Observations
AASHTO T 30	Mechanical Analysis of Extracted Aggregate
The Asphalt Institute's (AI) Manual No. 2 (MS-2)	Mix Design Methods for Asphalt Concrete
AI Manual No. 3 (MS-3)	Asphalt Plant Requirements and Aggregate Test Procedures
DCAD Specification Section T-611	Compaction Control Tests

USCE	Bulk Impregnated Specific Gravity Corps of Engineers Manual EM-1110-45-302 Appendix V and Supplements Thereto

END OF SECTION

Appendix I	Contractor's Quality Control Testing Procedures (3 pages)
Appendix II	Listing of Contractor's Furnished Laboratory and Field Testing Equipment (4 pages)
Appendix III	Dade County Aviation Department Laboratory Procedures Manual (DCADLPM) (63 pages)

APPENDIX I
CONTRACTOR'S QUALITY CONTROL
TESTING PROCEDURES

a) General. The Contractor shall provide and maintain a Quality Control Program in accordance with provisions of Section 01440 of Division 1, and the following requirements:

b) The assignment of quality control responsibility to specifically named individuals, who must be certified by Florida DOT to perform these tasks.

c) Quality Control Testing. The Contractor shall perform all quality control tests necessary to control the production and construction processes. The testing program shall include, but not necessarily be limited to, tests to determine the bitumen content, aggregate gradation, temperatures, asphalt absorption, Marshall tests, bulk specific gravity and on-site density. The Contractor shall employ such sampling procedures as necessary so that the required tests can be scheduled at equal intervals during the work day at the Plant Laboratory.

The Project Testing Laboratory technician and/or the Architect/Engineer may monitor any or all of the Quality Control Testing.

(1) Bitumen Content. A minimum of two extraction tests, using not less than 1000 gram samples, shall be performed daily in accordance with the DCADLPM, Section 5, for the initial determination of bitumen content. Whenever an extraction test result indicates that the bitumen content of the hot mix materials is not within the JMF allowable tolerances, then another sample shall be promptly taken by the Contractor and tested to verify the results of the previous failing test. In lieu thereof, the Contractor may, subject to prior written approval by the Architect/Engineer, utilize the printed tickets representing the same time period and truckload, to verify the bitumen content when Florida DOT approved automated recording plants are used for production (see the Bitumen Notes in Control Charts Limits, Article 401-6.5).

(2) Gradation. Aggregate gradations shall be determined a minimum of three times a day, from mechanical analyses of extracted aggregate and from mechanical analysis of plant bin samples. Aggregate samples without bitumen shall be taken from the pugmill, or drum feed belt (drum discharge), and from hot bins or drum cold bins and compared with the actual weight printout on automated asphalt plants. See DCADLPM, Sections 4 and 5.

For verification of minimum dust requirements, whenever the minimum 200 sieve (dry) fraction is less than 3 percent, a washed sieve analysis shall be performed on four (4) separately and randomly secured samples taken by dry trial runs from the pugmill or from the drum mixer on the asphalt plants.

(3) Temperatures. At least four times daily, temperatures shall be checked at necessary locations to determine the temperature of the aggregates discharged from the dryer, or the mixture discharged from the pugmill or drum discharge, the bitumen in the storage tank, the mixture in the trucks at the plant, and the mixture in the spreader at the job site as well as during the compaction process. See DCADLPM, Section 9.

Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor's option.

(4) Asphalt Absorption. Initial tests shall be made when designing the JMF and subsequently for each production period for each mix of asphalt concrete placed, as per ASTM D 2041. (Verification tests will be performed by the Project Testing Laboratory, and the Architect/Engineer may further direct the performance of additional tests using bulk impregnated specific gravities performed in accordance with the USCE procedure EM-1110-45-302).

(5) Marshall Tests. Tests for conformance to Marshall criteria shall be made daily for each sublot of the day for Quality Control Testing. One test shall be taken during the first hour of each production period (as directed by the Architect/Engineer or by the Project Testing Laboratory technician) and the other required test(s) shall be taken at random, in accordance with requirements of the Specifications.

(6) Bulk Specific Gravity. The bulk specific gravity of the aggregate blends of materials shall be retested at least once every 5,000 tons of plant production, in order to verify compliance with or to determine whether it is necessary to revise the approved job mix formula, but in any event not less than once a week.

(7) On-site Density Testing. The Contractor shall promptly determine the on-site density of the mat-in-place using the approved nuclear gauge device, and operated by a qualified operator, meeting the requirements of Appendix II of these Specifications. Determination of the in-place pavement density using the nuclear gauge shall be performed in accordance with the manufacturers written instructions and in accordance with the requirements of ASTM D 2950. These tests are informal, and shall be only used to aid the Contractor in evaluating the degree of compaction during the construction of each layer of the pavement. A target nuclear density value, based on the first hour Marshall density of the period and the updated core correction factor, shall be determined by the Contractor at the beginning of each sublot in a timely manner. Field density control measurements shall then be continuously made by the Contractor using the nuclear density instrument, operated concurrently and continuously with the rolling operations.

d) Control Charts. Control charts shall be maintained on the various sieve sizes, the blended gradations, the asphalt content of the mix, Marshall tests, JMF parameters, laboratory and field densities, aggregate stockpile bulk specific gravities, and maximum specific gravity. Each individual test shall be plotted. The charts shall contain four point moving averages, action limits, and production suspension limits. All charts shall be posted in full view in the Plant Laboratory and will be accessible to the Project Testing Laboratory Technician at all times.

e) Quality Control Deficiencies. The Contractor shall take prompt action to correct any errors, equipment malfunction, process changes, or other assignable causes which have resulted or could result in submission of materials and completed construction which do not conform to the requirements of the Specifications.

f) Documentation. The Contractor shall document his quality control efforts using copies of the sample forms contained in the DCADLPM, Appendix C, or equivalent approved forms. Test results shall be made available to the Architect/Engineer daily.

APPENDIX II

Listing of Contractor's Furnished Laboratory and Field Testing Equipment

The Contractor shall provide at each plant site, two testing laboratories for use of the producer's (Contractor) Quality Control Testing functions, and for use by the Project Testing Laboratory, during periods of production, sampling and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The testing laboratory shall meet the requirements of Section 01590 of Division 1, shall be certified by Florida DOT, shall meet the requirements of ASTM D 3666, and shall meet the following requirements:

The bituminous plant testing laboratory shall have a floor area of not less than 600 square feet (300 square feet available to the Architect/Engineer) with a ceiling height of not less than 7 1/2 feet. The laboratory shall be weather-tight, sufficiently heated in cold weather, air-conditioned in hot weather to maintain temperatures for testing purposes, of 70 plus or minus 5 degrees F. It shall be so located on the asphalt plant site as to provide an unobstructed view from one of its windows, of the trucks as they are loaded with the plant mixed materials.

The bituminous plant testing laboratory shall have:

(1) Adequate artificial lighting.

(2) Electrical outlets sufficient in number and capacity for operating the required testing equipment and for drying samples.

(3) Fire Underwriters' approved extinguishes.

(4) Two (2) work benches for testing with dimensions not less than 2 1/2 feet by 10 feet.

(5) A desk, a table or a counter, and at least two chairs.

(6) Sanitary facilities, conveniently located to the testing laboratory.

(7) Exhaust fan to outside air, with minimum blade diameter of 12" to adequately handle laboratory dust and fumes.

(8) Telephone, having at least one (1) outside line.

(9) File cabinet with four (4) drawers.

(10) A sink with running water and attached drainboard and drain capable of handling separable material.

(11) A metal stand to hold sieves used in washing separable material.

(12) A 4-element hot plate or other comparable heating device, with suitable dial type thermostatic controls to adjust the heat, for drying aggregates.

(13) Mechanical shaker and appropriate sieves conforming to requirements of current ASTM designation E-11 for determining the gradation of coarse and fine aggregates in accordance with ASTM C 136 or AASHTO T-27 and T-30.

(14) Testing equipment meeting the requirements of current Asphalt Institute Manual MS-2 and ASTM D 1559 as modified by AASHTO T-245, for the measurement of the resistance to plastic flow of compacted specimens of bituminous paving mixtures.

(15) Apparatus as specified in ASTM C 127, D 2172, D 2726, D 2041, AASHTO T-30, and other apparatus as required by the testing procedures listed in Testing Requirements of Specifications Section P-401 and listed in Section 7 of the DCADLPM. Extraction equipment capable of testing a minimum of 1000 gram samples shall be provided.

(16) A thermostatically controlled oven with minimum inside dimensions 2 feet on all sides (8 cubic feet minimum).

(17) A thermostatically controlled refrigerator, not less than 16 cubic feet capacity.

(18) Hooded stove with exhaust vented to the outside.

(19) Library containing the current copies of ASTM Volumes 4.03 and 4.04; ASTM E178; AASHTO Tests, Part II; Asphalt Institute Manuals MS-2 and MS-3; USCE Procedure Manual EM-1110-45-302; and Specifications Item P-401 including Appendixes I, II and III.

(20) Two insulated containers - five gallons each.

(21) The following auxiliary incidental tools and equipment:

Required Quantity per each laboratory	Description
2	Cold boxes for storage and transportation of samples.
1	6 ft. Folding Ruler
1	Sample Splitter with 3 pans.
1	Scoop
1	Bunson Burner with Ring and Stand
2	Beakers, 300 ml
2	Graduate Cylinders, 100 ml
1	Graduate Cylinder, 1000 ml
1	Graduate Cylinder, 2000 ml
2	Evaporating Dishes
1	Tongs
1	Thermometer 20° - 400°
1	Dillon Thermometer
1	Spatula
1	Hand Agitator for Filtrate
1	Sample Quarterer
2	Enamel wash basins
1	Stencil Brush
4	Buckets (or other adequate sample containers)

(22) The Contractor shall also furnish the following supplies:

Supply of Trichloroethylene (Cholroethene)
Packaged Steel Wool

Bottle of "Joy" dish detergent
Roll of Brown Paper (for quartering)
Sample Cartons
Quart Sample Cans
Sample Bags
Coarse and Fine Filter Paper
Gloves
Clean Rags
Broom and Dust Pan

(23) The Contractor shall also furnish all other apparatus, tools, or utensils listed in, or as required by the DCADLPM (Appendix III to Specification Item P-401).

(24) In addition to all the above listed items, the Contractor shall provide, at the construction site, an approved nuclear density gauge, equal to Model No. 3440, as manufactured by Troxler Electronic Laboratory or an approved equal; the nuclear density gauge proposed to be used shall have been factory calibrated within three (3) months from the time of its proposed use on the job site. The Contractor shall also furnish a qualified operator for the purpose of making informal, on-the-site nuclear test readings to determine density and control densification of the leveling and surface courses.

(25) Twelve foot (3.6 meters) aluminum straightedge or 10 foot (3.0 meters) FDOT straight edge, and a sixteen foot (4.8 meters) rolling straightedge, of a quality and type approved by the Architect/Engineer or FDOT.

Approval of the bituminous plant and testing laboratory by the Architect/ Engineer, will require that all the above facilities and equipment be in good working order, during all periods of mix production, sampling, and testing; and whenever materials subject to the provisions of Specification Section P-401, are being supplied or tested. Failure to provide any of the above shall be sufficient cause for disapproving the bituminous operations.

The Contractor is advised that in lieu of furnishing and equipping an additional testing laboratory for the exclusive use by the Project Testing Laboratory technician(s) as required to Article 401-3.5, the Architect/Engineer may approve the joint use of this laboratory by the Project Testing Laboratory technician and the Contractor's technician(s), provided that the Project Testing Laboratory technician will always have priority in the use of the equipment and facilities. In any case sufficient laboratory equipment must be provided such that both the Quality Assurance Testing and the Quality Control Testing can proceed in a timely manner as required by the Specifications.

DADE COUNTY AVIATION DEPARTMENT

LABORATORY PROCEDURES

MANUAL

(DCADLPM)

APPENDIX III

OCTOBER 1994

APPENDIX III
LABORATORY PROCEDURES MANUAL (DCADLPM)

CONTENTS

SECTION 1

INTRODUCTION

This manual presents procedures to be followed by:

1. Contractor's testing personnel in developing bituminous job mix formulas and in performing Quality Control Testing during plant production of bituminous paving mixture and,

2. The Architect/Engineer and the Project Testing Laboratory in performing acceptance testing on bituminous paving mixture produced by the plant and placed on the job under DCAD Specifications P-401.

There are in existence today a number of standard methods by which the properties of asphalt pavements may be measured to evaluate the design of the mixture and maintain control during production and construction.

The procedures required to obtain the desired results are outlined in considerable detail, and references are made where the methods are covered by ASTM, AASHTO, the Asphalt Institute, the U.S. Corps of Engineers (USCE) Standards and as outlined in Specification Item P-401.

<u>The Sections of the Manual which are to be fully or partially accomplished by the Contractor are</u>:

Section 2 - Design of Bituminous Paving Mixture, Job Mix Formula (JMF)
- Maximum Theoretical Specific Gravity of JMF(s)
- Bulk Specific Gravity of the Aggregate Blend(s)

Section 3 - Marshall Test; Stability, Flow, Density, Air Voids, Voids in Mineral Aggregates of Compacted Bituminous Paving Mixtures, percent

Section 4 - Hot Bins or Cold Bins and Pugmill or Drum Samples for Gradation Analyses

Section 5 - Extraction Test

Section 6 - Pavement Density, Percent Compaction: Nuclear Method

Section 7 - Laboratory Equipment

Section 8 - Method of Sampling Bituminous Mixtures - Figure 2, Page 74

Section 9 - Temperatures

The Sections of the Manual which are to be fully or partially accomplished by the Project Testing Laboratory are:

Section 2
- Check (Perform Design - Optional) Design of Bituminous Paving Mixture, Job Mix Formula(s)
- Maximum Theoretical Specific Gravity of JMF(s)
- Bulk Specific Gravity of the Aggregate Blend(s)

Section 3
- Marshall Tests; Stability, Flow, Density, Air Voids, Voids in Mineral Aggregate of Compacted Bituminous Paving Mixtures, percent.
- Daily Maximum Specific Gravity (Rice's) Test
- 5,000 Tons or Weekly Bulk Specific Gravity of Aggregate Blend Test

Section 4
- Check Hot or Cold Bins, and Pugmill or Drum Samples for Gradation Analyses.

Section 5
- Check Extraction Test

Section 6
- Pavement Density, Percent Compaction: Core Method[1]

Section 7
- Check Laboratory Equipment

Section 8
- Random Sampling Procedures, Frequency of Tests

Section 9
- Check Temperatures

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[1] The Project Testing Laboratory shall monitor the densification of the various courses and check each core sample location insitu density with their nuclear gauge prior to Contractor's coring. (Also see P-401-5.1, 5.2 and 5.3)

SECTION 2

Design of Bituminous Paving Mixture
Job Mix Formula; Modified Marshall Method

1. General Information

The Job Mix Formula (JMF) which is to be developed by the Contractor shall be prepared on the standard forms in Appendix III-A.

1.1 Preliminary Procedures - Prior to the preparation of test specimens, the following is required:

(a) Ascertain that the materials proposed for use meet the project Specifications. See Appendix III-A, Page 1a.

(b) Development of the JMF using aggregate samples from the pugmill, the drum discharge, the plant hot bins, the drum cold bins or from onsite stockpiles.

(c) Determination of the Bulk Specific Gravity of the JMF(s) Aggregate Blend. See Appendix IIIA, Page 3a.

1.2 Optimum Asphalt Content - At the optimum asphalt content of the mixture (based on the mandatory target of 4.0% Air Voids Content) the following is required:

(a) Three separate determinations of the Maximum Theoretical Specific Gravity (Rices) shall be obtained in accordance with the requirements of ASTM D 2041, Type D container using a minimum sample size of 2,000 gm. The average of not less than the three values obtained shall be used in the void analyses (discard aberrant tests and immediately rerun test(s) with fresh plant material samples).

(b) Three separate determinations of the Bulk Impregnated Specific gravity shall be obtained in accordance with the requirements of USCE Procedures Manual EM-1110-45-302 for use in establishing the amount of bituminous material in the mixture as prescribed in Subarticle 3.2. in Specification Section P-401.

A current copy of ASTM D 2041 and the USCE Manual EM-1110-45-302 shall be on hand in the Testing Laboratory Library as required in Appendix II to Technical Specification Section P-401.

2. Preparation of Test Specimens

2.1 General - In determining the optimum asphalt content for a particular blend or gradation of aggregates, a series of test specimens shall be prepared for a range of different asphalt contents so that test data curves showing well defined optimum values may be plotted. specimens shall be prepared on the basis of 1/4 percent increments of asphalt content, with at least two asphalt contents above optimum and at least two below optimum. (6.5, 6.75, 7.0, 7.25 and 7.5% A/C) (Appendix IIIB, Page 1)

NOTE: AGGREGATE GRADATION. When plotted on a 0.45 power gradation chart, the aggregate gradation for the JMF shall produce a grading curve with no abrupt changes and approximately parallel to the curves of the specified grading limits. A 0.45 power gradation chart is provided in Appendix III-A, Page 4.

To provide adequate data, not less than four test specimens shall be prepared for each asphalt content used. Thus, a design study using five different asphalt contents shall require a minimum of 20 test specimens.

NOTE: Each test specimen will usually require approximately 2.6 lbs (1.18 kg.) of aggregate. Therefore, the minimum aggregate requirements for one series of 20 test specimens of a given blend and gradation will be at least 55 lbs (25 kgs). Approximately one (1) gallon (3.78 liters) of bituminous material will be required.

2.2 Equipment - The equipment required for the preparation of test specimens is as follows:

(a) Pans, metal, flat bottom, for heating aggregates.

(b) Pans metal, round, approximately one (1) gallon capacity, for mixing asphalt and aggregate.

(c) Oven and hot plate, for heating aggregates, asphalt, and equipment as required.

(d) Scoop, for batching aggregates.

(e) Containers, tins, beakers, pouring pots, or sauce pans for heating asphalt.

(f) Thermometers, armored, glass, or dial-type with metal stem, 50°F (10°C) to 400°F (204°C), with sensitivity of 5.0°F (2.5°C) or less, for determining temperature of aggregates, asphalt and asphalt concrete mixtures. Thermometers shall be properly calibrated and rechecked periodically.

(g) Electronic balance, 4.5 kgs. (10 lbs) minimum capacity, sensitive to 0.5 gm. for weighing aggregates and asphalt and balance, 2-kg. (4.5 lbs) minimum capacity, sensitive to 0.1 gm. for weighing compacted specimens. Balances shall be properly calibrated and rechecked periodically.

(h) Mechanical shaker and appropriate sieves conforming to requirements of current ASTM designation E 11 for determining the gradation of coarse and fine aggregates.

(i) Large mixing spoon or trowel, for placing mixture in specimen molds.

(j) Large spatula for spading and hand mixing.

(k) Mixing apparatus, mechanical type required commercial bread dough mixer 4-quart capacity or larger may be used.

(l) Compaction Pedestal, consisting of an 8x8x18 in. (20 x 20 x 45 cm) wooden post capped with a 12x12x1 in. (30 x 30 x 2.5 cm) steel plate. The wooden post shall be oak, yellow pine or other wood having a dry weight of 42 to 48 lbs./ft.3 (675 to 770 kgs/cu. meter) The wooden post shall be secured by four angle brackets to a solid concrete slab constructed on solid ground. The steel cap shall be firmly fastened to the post. The pedestal shall be installed so that the post is plumb, the cap level, and the entire assembly free from movement during compaction.

(m) Compaction Mold, consisting of a base plate, forming mold, and collar extension. The forming mold has an inside diameter of 4 in. (10 cm.) and a height of approximately 3 in. (7.5 cm); the base plate and collar extension are designed to be interchangeable with either end of the forming mold.

(n) Mechanically operated Marshall compaction Hammer, consisting of a flat circular tamping face 4 in. (100 mm) diameter and equipped with a 10-lb. (4.5 kgs) weight constructed to obtain a specified 18 in. (45 cm) height of drop, meeting the requirements of Note 2 in AASHTO T 245. (FDOT or USCE Certified)

Disregard Note 5 in ASTM Test Method D-1559.

(o) Mold Holder, consisting of a spring tension device designed to hold the compaction mold in place on the compaction pedestal.

(p) Extrusion Jack or Arbor Press, for extruding compacted specimens from mold. (Method designated in ASTM D 1559, Art. 4.5.2)

(q) Gloves, insulated, for handling hot equipment.

(r) Indelible paint type marking crayons, for permanently identifying specimens.

2.3 Test Specimens - The actual preparation of the test specimens shall be as follows:

(a) Five (5) Specimens shall be prepared for each combination of aggregates and asphalt content.

(b) Preparation of Aggregates - Aggregates shall be dried to constant weight at 300°F to 325°F (150° C to 163° C) and separated by dry-sieving into the desired size fractions.

(c) Mixing Temperature - The temperature to which the asphalt must be heated to produce a kinematic viscosity of 170 $\pm$ 20 centistokes shall be established as the mixing temperature. Use the current Temperature/Viscosity Chart furnished by the bituminous material supplier.

(d) Preparation of Mixture - Weigh into separate pans for each test specimen the amount of each size fraction from (b) above, required to produce a batch that will result in a compacted specimen 2.5 $\pm$ 0.05 in. (62.5 mm $\pm$ 1.25 mm) in height. This will normally be about 2.6 lbs. (1.15 kgs).

Place the pans in the oven or on the hot plate and heat to a temperature of approximately 50°F (10°C) above the mixing temperature specified in (c) above.

Charge the mixing bowl with the heated aggregates and dry mix thoroughly. Form a crater in the dry blended aggregates and weight the required amount of asphalt cement into the mixture in accordance with the accumulative batch weights. At this point the temperature of the asphalt and aggregate must be within the limits of the mixing temperature established in (c) above. Asphalt cement should not be held at mixing temperature for more than one hour before using, and shall be kept covered. Mix the asphalt and aggregate, preferably with a mechanical mixer, or by hand with trowel, as quickly and thoroughly as possible to yield a mixture having a uniform distribution of asphalt throughout.

(e) Preparation of Mold and Hammer - Clean the specimen mold assembly and the face of the compaction hammer and heat them to a temperature between 250°F and 275°F (121°C and 135°C) in an oven or on a hot plate. Place a piece of filter paper in the bottom of the mold before the mixture is placed in the mold.

(f) Compaction of Specimens - Place the mixture in the mold, spade the mixture vigorously with a heated spatula or trowel 15 times around the perimeter and ten times over the interior. Remove the collar and smooth the surface to a slight rounded shape. THE TEMPERATURE OF THE MIXTURE IMMEDIATELY PRIOR TO THE COMPACTION SHALL BE 250° $\pm$ 5°F (121° $\pm$ 2.5°C). Once the temperature of the material has fallen below 245°F (118°C), it shall not be reheated, but shall be discarded.

Replace the collar, place the mold assembly on the compaction pedestal in the mold holder. Apply 75 blows with the mechanical compaction hammer using a free fall of 18 in. (45 cm). Remove the base plate and collar, and reverse and reassemble the mold. Apply the same number of compaction blows to the face of the reversed specimen.

NOTE: Only mechanically operated Marshall compactor hammers meeting the requirements of AASHTO T 245 shall be used. Since the production testing must use the same manufacturer's model of hammer as used in the JMF, the laboratory shall ensure that the same manufacturer's model hammer is available at the plant laboratory.

After compaction, remove the base plate and allow the specimen to cool in air until no deformation will result when removing it from the mold. When more rapid cooling is desired table fans may be used.

Remove the specimen from the mold by means of the Marshall Testing Machine or an extrusion jack or other compression device and place on a smooth, level surface until ready for testing.

3. Test Procedures

3.1 General - In this modified Marshall method each compacted test specimen shall be subjected to the following tests and analysis in the order listed:

(a) Perform Bulk Specific Gravity tests as soon as specimens have cooled.

(b) Perform Density and Voids Analyses as soon as the bulk specific gravity tests have been performed. Use the current test data from daily maximum specific gravities of the JMF(s) and from 5,000 U.S. tons (4465 metric tons) or weekly bulk specific gravities of the aggregate blend of materials.

(c) Perform Stability and Flow tests the day following the preparation of the specimens (results may be erratic if performed sooner).

3.2 Equipment - The equipment required for the testing of the specimens is as follows:

(a) Electronic balance, 2 kg. (4.5 lbs) minimum capacity, sensitive to 0.1 gm. to enable bulk specific gravities of the specimens to be calculated to at least four significant figures, i.e., to at least three decimal places. It shall be equipped with a suitable suspension apparatus and holder to permit weighing the specimen in water while suspended from the center of the scale pan of the balance. The balance shall be properly calibrated and rechecked periodically.

(b) Water bucket, suitable for weighing compacted specimens in water, with a suitable overflow device to maintain a constant water level.

(c) Marshall Testing Machine, electrically powered (110 volt). Designed to apply loads to test specimens through semi-circular testing heads at a constant rate of 2 in. (50 mm) per minute. It is equipped with a calibrated proving ring for determining the applied load, a stability testing head for use in testing the specimens, and a flow meter for determining the amount of deformation at the maximum load for test. The machine should be equipped with an automatic readout to record the load/deformation diagram. The testing machine shall be properly calibrated and shall be rechecked periodically.

(d) Water Bath, at least 6 inches (15 cm) deep and thermostatically controlled to $140^\circ \pm 1.8^\circ$F ($60^\circ \pm 1^\circ$C). The tank shall have a perforated false bottom or be equipped with a shelf for suspending the specimens at least 2 inches (50mm) above the bottom of the bath.

(e) Thermometers, for water bath with a range of 134° to 144°F (57° to 62° C), sensitive to 0.4°F (0.20°C), thermometer to verify 77°F (25°C) in water used for bulk specific gravity. The thermometers shall be properly calibrated and rechecked frequently.

3.3 Bulk Specific Gravity Determination - The bulk specific gravity test may be performed as soon as the freshly compacted specimens have cooled to room temperature.

This test shall be performed according to ASTM D 2726, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface - Dry Specimens. Procedure 9.2 of ASTM D 2726 for Thoroughly Dry Specimens, shall be followed.

A copy of ASTM D 2726 shall be on hand in the Testing Laboratory Library as required in Appendix II to Specification Section P-401.

3.4 Stability and Flow Tests - After the bulk specific gravity of the test specimens have been determined, the stability and flow tests shall be performed as follows:

(a) Adjust the flow meter to zero.

(b) Immerse the specimens in the water bath at 140° ± 1.8°F (60° ± 1°C) for 30 to 40 minutes before test.

(c) Thoroughly clean inside surfaces of testing head. Temperature of head shall be maintained at from 100° to 140°F (38° to 60°C) using a water bath when necessary. Lubricate guide rods with a thin film of oil so that the upper test head will slide freely without binding. When a proving ring is used to measure applied load, check that dial indicator is firmly fixed and zeroed for the no-load position.

(d) With testing apparatus in readiness, remove test specimen from water bath and carefully dry surface. Place specimen in lower testing head and center; then fit upper testing head into position and center complete assembly in loading device. Place flow meter, adjusted to zero, over guide rod.

(e) Apply testing load to specimen at constant rate of deformation, 2 inches (50 mm) per minute, until failure occurs. The point of failure is defined by the maximum loading reading obtained. The total number of pounds required to produce failure of the specimen at 140°F (60°C) shall be recorded as its measured Marshall Stability value. If necessary, a conversion shall be made on the basis of measured volume as per Paragraph 4.1 (a) of this Section. When using the automatic readout, should more than one peak of the load-deformation curve be obtained, the first peak obtained shall be used for the stability and flow values.

(f) While the stability test is in progress, hold the flow meter firmly in position over the guide rod and remove when the load begins to decrease; record reading. The reading is the flow value for the specimen, expressed in units of 1/100 inches (0.25 mm), i.e., if the specimen deformed 0.15 in. (3.75 mm) the flow value is 15.

(g) Whenever it is necessary to perform the flow and stability tests the same day, a full set of additional test specimens shall be prepared from the same Marshall sample for confirmation tests to be performed the following day.

NOTE: THE ENTIRE PROCEDURE, BOTH STABILITY AND FLOW TESTS, STARTING WITH THE REMOVAL OF THE SPECIMEN FROM THE WATER BATH, SHALL BE COMPLETED WITHIN A PERIOD OF 30 SECONDS.

3.5 (a) If the Tensile Strength Ratio (TSR) of the composite mixture (ASTM D-4867) is determined to be less than 75, then the aggregates shall be rejected or the asphalt treated with an approved anti-stripping agent to produce a TSR greater than 75.

(b) Index of Retained Stability - The index of retained stability of Marshall specimens prepared at the JMF asphalt cement content shall be determined in accordance with the procedure in Appendix III-A. Should the index be less than 75 percent, the aggregates shall be rejected.

(c) When aggregates are rejected then other aggregates from a different source shall be supplied and tested.

3.6 Density and Voids Analyses - a density and voids analyses shall be made for each series of test specimens as follows:

(a) Average the bulk specific gravity values for all test specimens of a given asphalt content; values obviously in error shall not be included in the average.

(b) Determine the average unit weight for each asphalt content by multiplying the average bulk specific gravity value by 62.4 lb./ft3 (1000 kgs/cu. meter).

(c) Calculate Percent Air Voids in Compacted Mixture using the following formula:

$Pa = 100 - 100\ (G_{mb} \div G_{mm})$ or $Pa = 100\ [(G_{mm} - G_{mb}) \div G_{mm}]$

Asphalt Institute MS-2 Method

where:

P_a = Air voids in compacted mixture, percent of total volume

G_{mb} = Bulk specific gravity of compacted mixture

G_{mm} = Maximum specific gravity of mixture as determined from ASTM D 2041 and validated by the USCE Bulk Impregnated Specific Gravity test. (NOTE: Results derived from the USCE test generally indicate 0.1%-0.2% greater absorbed asphalt content than the results derived from the specified Rice's test method).

Examples

G_{mb} = 2.205

G_{mm} = 2.285

(MS - 2 Method)

$P_a = 100 - 100\ \frac{(2.205)}{(2.285)}$ $\quad$ $P_a = 100 \times \frac{(2.285 - 2.205)}{(2.285)}$

$P_a = 100 - 100\ (0.9650)$ $\quad$ $P_a = 100\ (0.0350)$

$P_a = 100 - 96.50 = 3.50$ $\quad$ $P_a = 3.50$

(d) Calculate Percent Voids in Mineral Aggregate (VMA) in Compacted Mixture using the following formula:

$$VMA = 100 - [G_{mb}P_s \div G_{sb}]$$

where:

VMA = Voids in Mineral Aggregate, percent of total volume

G_{sb} = Bulk specific gravity of Aggregate blend

G_{mb} = Bulk specific gravity of compacted mixture

P_s = Aggregate, percent by total weight of mixture

Example

$G_{sb} = 2.450$
$G_{mb} = 2.205$
$P_s = 92.6$

$$VMA = 100 - \frac{2.205 \times 92.6}{2.450}$$

$$VMA = 100 - \frac{203.963}{2.450}$$

$$VMA = 100 - 83.340$$

$$VMA = 16.66\%$$

4. Interpretation of Test Data

4.1 Preparation of data - The stability and flow values, and voids data shall be prepared as follows:

(a) Measured stability values for specimens that depart from the standard 2 1/2-inch (62.5 mm) thickness shall be converted to an equivalent 2 1/2-inch (62.5 mm) value by means of a conversion factor as shown in Table 1. The conversion shall be made on the basis of measured volume only, Appendix III-A, Page 5, column F of the standard form. Specimens below 2 1/4 in. (56 mm), and over 2 3/4 in. (69 mm), in thickness shall be discarded.

(b) Average the values for each parameter for all specimens of a given asphalt content. Values that are obviously in error shall not be included in the averages.

(c) Prepare a separate graphical plot for the following values as illustrated in Appendix III-B:

Stability vs. Asphalt content
Flow vs. Asphalt content
Unit Weight vs. Asphalt content
% Air Voids vs. Asphalt content
% Voids in Mineral Aggregate vs. Asphalt content

In each graphical plot connect the plotted values with a smooth curve that best fits all the values.

TABLE 1 - STABILITY CORRELATION RATIOS

VOLUME OF SPECIMEN cm^3*	CORRELATION RATIO
406 to 420	1.47
421 to 431	1.39
432 to 443	1.32
444 to 456	1.25
457 to 470	1.19
471 to 482	1.14
483 to 495	1.09
496 to 508	1.04
509 to 522	1.00
523 to 535	0.96
536 to 546	0.93
547 to 559	0.89
560 to 573	0.86
574 to 585	0.83
586 to 598	0.81
599 to 610	0.78
611 to 625	0.76

* To convert cm^3 to in^3 multiply by the factor of 0.061

4.2 Determination of Optimum Asphalt Content - The optimum asphalt content of the asphalt paving mix shall be determined as explained in Appendix III B.

When the procedures in Appendix III-B do not result in a JMF which meets the specification parameters, or results in a JMF which marginally meets the design parameters or results in a mix which may be difficult to produce or to compact in the field, then the aggregate blend must be revised or a new source of aggregates secured, and a new set of JMF data developed. SINCE THE ACCEPTANCE BY THE ARCHITECT/ENGINEER OF PLANT-PRODUCED MATERIAL WILL BE BASED ON BOTH MARSHALL CHARACTERISTICS OF PLANT-PRODUCED MATERIAL AND DENSITY OF IN-PLACE MATERIAL, IT IS IMPERATIVE THAT A JMF BE DEVELOPED WHICH CAN BE READILY PRODUCED AND IS COMPACTABLE IN THE FIELD WITHOUT CRUSHING AGGREGATE PARTICLES.

4.3 Verification of Job Mix Formula Characteristics - When the asphalt content for the proposed job mix formula does not coincide with an asphalt content used in the trial specimens, an additional set of not less than four (4) specimens shall be prepared at the proposed job mix formula asphalt content to verify that actual results duplicate those anticipated from the curves.

4.4 Use of Standard Forms - All data and computations used in developing the job mix formula shall be entered on the standard forms shown in Appendix III-A.

4.5 NOTES

(a) Special Requirement For Dryer Drum Plant. When a dryer drum mix plant is to be used, the Contractor shall proof the proposed Job Mix Formula by conducting a production run and verifying that material actually produced by the plant can meet the production criteria at the Job Mix Formula asphalt content. The data will be developed in accordance with the procedures contained in this section and presented to the Architect/Engineer with the job mix formula for approval.

When a bituminous concrete mixture produced by a dryer drum mix plant drifts away from the properties of the approved laboratory designed JMF, then the JMF shall be modified as necessary to permit the production of bituminous concrete mixture meeting specification requirements.

(b) Mixes designed with stabilities greater than 3,500 pounds (15,555 newtons) may result in mixtures difficult to compact to the required density without damaging the large aggregate particles.

(c) Marshall test specimens prepared from plan produced mix materials during a normal production run shall not exceed a unit weight variation of plus or minus 1.5 pounds. A single errant test specimen may be discarded and the tests performed on the other 4 specimens. Resample and rerun test procedures if a second test specimen exceeds the 3 pound range.

SECTION 3

Marshall Test

1. General Procedures

This test shall be performed in two separate phases as indicated below:

Phase 1 - Prior to the start of plant production to verify the JMF by the Project Testing Laboratory.

Phase 2 - Fixed requirement, during the entire production of the paving mix, including the Trial Test Section and Control Test Section(s). (See 3.3 TEST SECTION of the Technical Specifications)

1.1 Phase 1

Prior to the start of plant production, the Contractor shall deliver to the Project Testing Laboratory samples of the aggregates and asphalt used by him to develop the job mix formula.

Using the samples provided by the Contractor, the laboratory shall:

(a) Ascertain that the materials proposed for use meet the project Specifications. See Appendix III-A, Page 1a.

(b) Prepare and test, twelve (12) compacted Marshall specimens at three Asphalt Cement content levels; one set of tests at the JMF optimum Asphalt Cement content proposed by the Contractor and four sets two above and two below that JMF optimum Asphalt Cement content; and independently determine and validate the maximum specific gravity of the mixture, all in accordance with the procedures followed by the Contractor in Section 2 of this manual, to verify the job mix formula.

1.2 Phase 2

During the production of the paving mix, including the Trial Test Sections and Control Test Sections, the Project Testing Laboratory shall, on a sublot basis, determine the following characteristics of the mixture:

(a) Stability, compacted mixture, lbs.
(b) Flow, compacted mixture, 0.01 in. (0.25 mm)
(c) Unit Weight, compacted mixture, lbs./ft3 (kgs/ cu. meter)
(d) Air Voids, compacted mixture, percent
(e) Voids in Mineral Aggregate, compacted mixture, percent

The procedures to be followed for the Phase 2 evaluation shall be described below.

2. Preparation of Test Specimens

2.1 General - To provide adequate data, not less than four test specimens shall be prepared for each evaluation. Material for the specimens shall be obtained from the plant in accordance with the procedures outlined in Section 8 Sampling Procedures, and placed in a covered and insulated container and then transferred to the plant laboratory's oven, until ready for use.

2.2 Equipment - The equipment required for the preparation of test specimens shall be the same as specified under Sub-Article 2.2, in Section 2 of this DCADLPM.

2.3 Test Specimens - The actual preparation of the test specimens shall be the same as specified under Sub-Article 2.3 in Section 2 of this DCADLPM.

3. Test Procedures

3.1 General - In this modified Marshall method each compacted test specimen shall be subjected to the tests and analyses as specified under Sub-Article 3.1 in Section 2 of this DCADLPM.

3.2 Equipment - The equipment required for the testing of the specimens is the same as specified under Sub-Article 3.2 in Section 2 of this DCADLPM.

3.3 Bulk Specific Gravity Determination - The bulk specific gravity tests shall be performed in accordance with the provisions in Sub-Article 3.3 in Section 2 of this DCADLPM.

3.4 Density and Voids Analyses - After completion of the bulk specific gravity tests, a density and voids analysis shall be made for each series of test specimens as follows:

(a) Average the bulk specific gravity values for all test specimens. Values obviously in error shall not be included in the average. However, a written justification shall be included in the data when a sample is discarded.

(b) Determine the average unit weight by multiplying the average bulk specific gravity value by 62.4 lbs./ft3 (1000 kgs/cu. meter).

(c) In the Air Voids calculations use the value of the maximum specific gravity of the mixture determined in accordance with ASTM D 2041, using a Type D Container.

During production, the Maximum Specific Gravity shall be determined by ASTM D 2041 a minimum of once for each days production of material. The value used in Air Void analysis calculations shall be the value obtained that day. A minimum sample size of 2,000 gm shall be used.

(d) Calculate Percent Air Voids in Compacted Mixture in accordance with the procedure specified under Subarticle 3.6.(c) in Section 2 of this DCADLPM.

(e) In the Voids in Mineral Aggregate (VMA) calculations use the value of the Bulk Specific Gravity of the Aggregate Blend determined in accordance with ASTM C-127 and C-128 and by the method shown in Appendix III A Page 3a.

During production, the Bulk Specific Gravity of the Aggregate Blend shall be determined by ASTM C-127 and C-128 and by the method shown in Appendix III A Page 3a at least once every 5,000 U.S. tons (4,465 metric tons) of plant production but not less than once a week. The value used in the VMA analysis calculations shall be the current weekly value.

(f) Calculate Voids in Mineral Aggregate in Compacted Mixture in accordance with the procedure specified under Subarticle 3.6(d) in Section 2 of this DCADLPM.

3.5 Stability and Flow Test - After the bulk specific gravities of the test specimens have been determined, the stability and flow tests shall be performed in accordance with the provisions specified in Sub-Article 3.4 in Section 2 of this DCADLPM.

Standard worksheets for the above data and calculations are included in Appendix III-C.

SECTION 4

Hot or Cold Bins, Pugmill or Drum Samples (without Bitumen) Gradation Analyses

1. General Information - Aggregate sample gradation analyses shall be performed daily by the Contractor as part of his required Quality Control Testing and checked by the Project Testing Laboratory. The purpose of these tests is to determine the aggregate gradation of each bin and the theoretical or actual gradation of combined proportions of aggregates.

2. Sampling Procedure and Frequency - The sampling procedure shall be in accordance with the methods described in Section 8 of this DCADLPM and the frequency of tests shall be in accordance with the Contract Specifications P-401.

3. Equipment and Test Procedure - The equipment required and the test procedure to be followed for the determination of the particle size distribution of aggregates extracted from each sample location shall be in accordance with ASTM C 136 and C-117. The Washed Sieve Analysis (Aggregates) procedure "B" (with wetting agent) contained in ASTM C-117 shall be utilized to determine the true minus 200 (0.075 mm) sieve (dust) fraction.

4. Use of Standard Forms - Standard forms for the hot bins gradation analyses data and calculations are included in Appendix III-C.

SECTION 5

Extraction Test

1. General Information - Extraction tests shall be performed by the Contractor as part of his required Quality Control Testing and checked by the Project Testing Laboratory. The purpose of the test is to determine or verify the bitumen content and aggregate gradation in the pavement mixture (See Note below charts in subarticle 401-6.5 Control Charts).

2. Sampling Procedure and Frequency - The sampling procedure shall be in accordance with the methods described in Figure 2 of Section 8 of this manual and the frequency of tests shall be in accordance with the Contract Specifications, or more frequently as directed by the Architect/Engineer.

3. Equipment and Test Procedure - Bitumen Content - The equipment required and the test procedures to be followed for the determination of the bitumen content in the paving mixture shall be in accordance with ASTM D 2172 and as specified in Appendix II of Specification Section P-401, except as indicated below.

3.1 Moisture Content - The determination of the moisture content of the paving mixture, as indicated in ASTM D1461 shall be performed by the Contractor and checked by the Project Testing Laboratory at the beginning of each work shift and more frequently as directed by the Architect/Engineer. The following standard laboratory test procedure derived from ASTM C-566 may be utilized when rapid test results are required:

- Obtain a Marshall sample and promptly transport to the Plant Laboratory in an approved sealed container.
- Determine wet weight of the total sample immediately.
- Dry sample to constant weight in the Laboratory oven at 255-260°F (124-127° C) [250°F ± 5° (121 ± 3° C) if sample is to be used for Marshall tests].
- Determine dry weight of the total sample.
- The percent loss in weight of dry sample represents the actual percent moisture content in the original sample of the asphaltic concrete mix materials.

3.2 Weight of Ash - The weight of ash portion of the extraction test, as described in ASTM D 2172 shall be determined as part of every extraction test performed for the duration of plant production for the Project. The weight of ash value obtained from the extraction tests shall be used in the calculation of the bitumen content of the mixture samples.

4. Equipment and Test Procedure - Aggregate Gradation - The equipment required and the test procedures to be followed for the determination of the aggregate gradation in the pavement mixture shall be in accordance

with the AASHTO T-30 Test. Washed sieve analysis in accordance with ASTM C-117 Procedures "B" (with wetting agent) shall be required.

5. Use of Standard Forms - Standard forms for the desired extracting test data and calculations are included in Appendix III-C.

SECTION 6

Pavement Density, Percent Compaction

A. Core Method

1. General Information

This method covers the procedure for determining the field density and percent compaction of the finished bituminous pavement by means of cored samples. Field density refers to the density expressed in pounds per cubic foot of the compacted material in place at the site and the percent compaction is defined as the density of the compacted material expressed as a percentage of the density of laboratory prepared specimens.

2. Sampling

2.1 Equipment - The Contractor shall furnish the manpower and equipment required for obtaining the finished bituminous pavement core samples as follows:

(a) Core drill, equipped to core and retrieve specimens.

(b) Drill bits; diamond, water cooled. Bit size shall be such as to provide a minimum core diameter of 6 $\pm$ 1/4 in. (150 $\pm$ 6.25 mm).

(c) Wet vacuum system to remove all water and drill cuttings from the surface of the pavement.

(d) A rigid plate and suitable well insulated container large enough to hold the samples without distortion after removal from the pavement.

(e) Indelible paint type marking crayons.

2.2 Sampling Procedures - The random procedures for obtaining the pavement samples shall be as follows:

(a) Wait until the pavement cools to ambient temperature but not less than 24 hours after placement.

(b) The Architect/Engineer will select the locations to be cored in accordance with the sampling procedures described in Section 8 of this DCADLPM.

(c) The Contractor shall core the samples and remove all loose particles and foreign matter. All broken or damaged edges of samples shall be carefully trimmed. The samples shall consist only of the material for which the test data are desired, i.e., when the material has been placed in more than one lift and only the top lift is to be evaluated, other material shall be separated by sawcutting and removed in such a manner as not to disturb the desired sample. The cores shall be cut perpendicular to the lift surface and taken in the presence of the Architect/Engineer or the technician of the Project Testing Laboratory.

(d) Identify the samples with the indelible marking crayon and place in a well insulated container upside down. Store in safe, cool place until ready for test.

NOTE: Not less than two additional core samples (factor samples) shall be taken from the location where the truckload of asphalt mix material, sampled by the Contractor for Marshall Tests during the first hour of regular plant production, was placed in the paving lanes. These special factor samples will not be included with the Lot core samples but shall be compared with the Contractor's first hour Marshall unit weight to establish or verify the days correlation/correction factor for the Contractor's use in performing Quality Control Testing during compaction using the Nuclear Testing Device(s).

3. Testing

3.1 Equipment - The equipment required for determining the pavement density and percent compaction shall be as follows:

(a) Electronic balance, 2 kg (4.5 lbs) minimum capacity, sensitive to 0.1 gm to enable bulk specific gravities of specimens to be calculated to at least four significant figures, i.e., to at least three decimal places. It shall be equipped with a suitable suspension apparatus and holder to permit weighing the specimens in water while suspended from the center of the scale pan of the balance. The balance shall be properly calibrated.

(b) Water bucket, suitable for weighing compacted specimens in water, and thermometer to measure water temperature at 77°F (25°C).

3.2 Testing Procedures - Each cored pavement sample shall be subjected to the following test and analysis in the order listed:

(a) Bulk Specific Gravity
(b) Percent Compaction
(c) Pavement Density

3.3 Bulk Specific Gravity Determination - This test shall be performed according to ASTM D 2726, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface - Dry Specimens. Procedure 9.2 of ASTM D 2726 for Thoroughly Dry Specimens shall be followed.

A current copy of ASTM D 2726 shall be on hand in the Testing Laboratory as required in Appendix II to Specification Section P-401.

3.4 Pavement Density - For each Sublot core densities shall be determined as follows:

Determine the density of the individual cores in pounds per cubic foot by multiplying the bulk specific gravity value by 62.4 lbs./ft3 (1000 kgs/cu. meter). The Project Testing Laboratory shall randomly obtain plant produced materials in accordance with the requirements of Section 8 of this DCADLPM for each sublot and shall prepare one set of Marshall laboratory compacted specimens for each sublot in accordance with the procedure in Section 3 of this DCADLPM and determine the average bulk specific gravity of each set.

3.5 Percent compaction - Calculate the percent compaction using the following formula:

$$\text{Percent Compaction} = \frac{\text{Core Density}}{\text{Average Laboratory Density}} \times 100$$

where:

Core Density is obtained from Paragraph 3.4.

Average Laboratory Density is the average of the laboratory densities of the sublot of material tested by the Project Testing Laboratory.

Example:

Core Density = 135.4 lbs./ft^3 (2170 kgs/cu. meter)
Average Laboratory Density (per sublot) = 137.5 lbs./ft^3 (2203 kgs/cu. meter)

$$\text{Percent Compaction} = \frac{135.4}{137.5} \times 100 = 98.5\%$$

SECTION 7

Laboratory Equipment

1. This equipment required for the development of the job mix formula is listed in Appendix II to Specification Item P-401 and in this manual as follows:

(a)	Equipment required for the preparation of test specimens	Section 2, Par.2.2
(b)	Equipment required for the testing of the specimens	Section 2, Par. 3.2

2. The equipment required for the Marshall Test is listed in this manual as follows:

(a)	Equipment required for the preparation of test specimens	Section 3, Par. 2.2
(b)	Equipment required for the testing of the specimens	Section 3, Par. 3.2

3. The equipment required for determining field density of the finished bituminous pavement by the core method is listed in this manual as follows:

(a)	Equipment required for obtaining the finished Pavement samples	Section 6, Par. 2.1
(b)	Equipment required for determining the pavement density	Section 6, Par. 3.1

4.	The equipment required for hot bins or drum sample gradation analyses	ASTM C 136 & ASTM C-117 (Wetting Agent) Asphalt Institute MS-3
5.	The equipment required for the extraction test:	
	(a) moisture content	ASTM D 1461 or Modified ASTM C-566 Section 5 Par. 3.1
	(b) weight of ash & bitumen content	ASTM D 2172
	(c) Aggregate gradation	ASTM C 136 & ASTM C-117 (Wetting Agent) Asphalt Institute MS-3
6.	The equipment required for Bulk Specific Gravity of Aggregate	ASTM C 127 & C 128

	Blend Test	Appendix IIIA, Page 3a
7.	The equipment required for Maximum Theoretical Specific Gravity Test using the Type D Container	ASTM D 2041 Appendix IIIA, Page 2 Appendix IIIF, Pages 1 & 2
8.	The equipment required for Bulk Specific Gravity of Compacted Mixture Test	ASTM D 2726 Appendix III-D, Page 2
9.	The equipment required for the Bulk Impregnated Specific Gravity Test	USCE EM-1110-45-302 Appendix III-F, Page 3

10. The equipment required for the Determination of Moisture Content in the Bituminous Paving Mixture. When sampled at the plant and at the testing laboratory.

NOTE: The Contractor shall ensure that the required equipment is available in the testing laboratory.

SECTION 8

A. Random Sampling Procedures for Sampling Plant Produced Material

1. From the Contract Specifications determine the sublot size - it can be time or a selected tonnage [such as 300 U.S. tons (268 metric ton)]. See Note 1 below.

2. Determine the number of increments per sublot to be used in the random sampling process, e.g., 10 minute increments for time or 20 U.S. ton (17.9 metric ton) increments for tonnage.

3. Place consecutively numbered one-inch square pieces of cardboard, equal to the number of increments to be used, into a container (such as a bowl). Mix them thoroughly and draw out 1 piece. The number on the square drawn represents the increment to be sampled for that sublot.

4. Replace the drawn piece into the container and repeat the process for subsequent sublots.

Example:

1. Sublot size - 2 hours (Plant on 8-hour day)

2. Time increment - 10 minutes. The number of increments is, therefore, 120 min. divided by 10 = 12

3. From 12 consecutively numbered pieces of cardboard thoroughly mixed is drawn the number 9.

4. The sample is to be taken from the truck being filled 10 minutes x 9 = 90 minutes after the sublot time frame starts.

NOTES:

1. When silos are being used the increments shall be based on tonnage.

2. For procedures to be used to sample the bituminous mixtures at the plant see ASTM D 979 and FIGURE 2 in this Section.

3. The Contractor shall take the first Marshall sample of each discrete paving period during the first hour of Asphalt Plant production.

B. <u>Random Sampling Procedures for Sampling of Field Compacted Material</u>

1. From the Contract Specifications determine the <u>lot</u> size and the number of sublots per lot (n=3 minimum).

2. Determine the total length and width of the individual paving lanes placed in the <u>sublot</u>.

3. Select a column of random numbers in Table 1 by placing 28 one-inch (25 mm) square pieces of cardboard numbered 1 through 28 into a container (such as a bowl), shaking them till they are thoroughly mixed and drawing out one.

4. Go to the column of random numbers identified with the number drawn from the container. In sub-column A locate all numbers equal to and less than the number of sublots, i.e., 01, 02, 03, 04.

5. Multiply the total length of the paving lanes in the sublot by the decimal value obtained in sub-column B found opposite the number used from sub-column A. This is the longitudinal station of the sampling point from the beginning of the sublot.

6. Multiply the total width of the individual paving lanes by the decimal value in sub-column C opposite the number used from sub-column A. This will be the sampling offset for the associated longitudinal station measured from the reference edge of the paving lane.

7. Where step 5 or 6 indicates the test should be taken at less than 2 feet (60.0 cms) from a pavement edge or 1 foot (30.0 cms) from a joint, the test shall be taken at these minimum distances instead.

8. Go completely through a column before using the same number over. If, for example, the plan calls for four core sample increments per lot, the first time a column is used, the first four locations would correspond to numbers 01-04 in sub-column A; the second time that column is used, numbers 05-08 would be used; and so forth.

Example: A 12 1/2' (3.75 m) paver places a 1200' (360 meters) lot of material in three adjacent lanes - see Figure 1. The Contract Specifications require that at least four core samples shall be taken per lot. An additional core sample shall be taken as ordered by the Architect/Engineer or as needed to replace a sample when such a sample is obviously defective, damaged or considered to be "Outlier" as per Sub-Article 5.3c in Specification Section P-401.

1. The number 12 is drawn from the container.

2. The random numbers selected from column 12 in Table 1 for a four sample sublot are as follows:

<u>Column No. 12</u>

A	B	C	
04		.153	.163
01		.320	.212
02		.489	.827

03	.542	.352

NOTE: The numbers shown in Column A are in the order found in Table 1, Column 12.

3. Divide the lot into four equal sublots. $\frac{1200}{4}$ = 300' or; $\frac{360}{4}$ = 90 meters

The sampling locations for the mat cores are as follows:

Sublot	Longitudinal Distance (From the Beginning) of the Sublot	Offset*
4	300' x .153 = 46' (90m x .153 = 13.8m)	12.5' x .163 = 2' (381 x .163 = 0.62m)
1	300' x .320 = 96' (90m x .320 = 28.8m)	12.5' x .212 = 3' (381 x .212 = 0.81 m)
2	300' x .489 = 147' (90m x .489 = 44.0m)	12.5' x .827 = 10' (381 x .827 = 0.32 m)
3	300' x .542 = 163' (90m x .542 = 48.8 m)	12.5' x .352 = 4' 381 x .352 = 0.13 m)

*Offsets referenced from left side of lanes.

Referring to figure 1, sample increment #1 would be taken 96' (28.8 meters) from the start of sublot 1; #2 would be taken 147' (44 meters) from the start of sublot 2; #3 would be taken 163' (48.8 meters) from the start of sublot 3, and #4 would be taken 46' (13.8 meters) from the start of sublot 4.

The sampling locations for the companion joint cores shall be at inboard joint opposite the sampling locations determined for the mat cores.

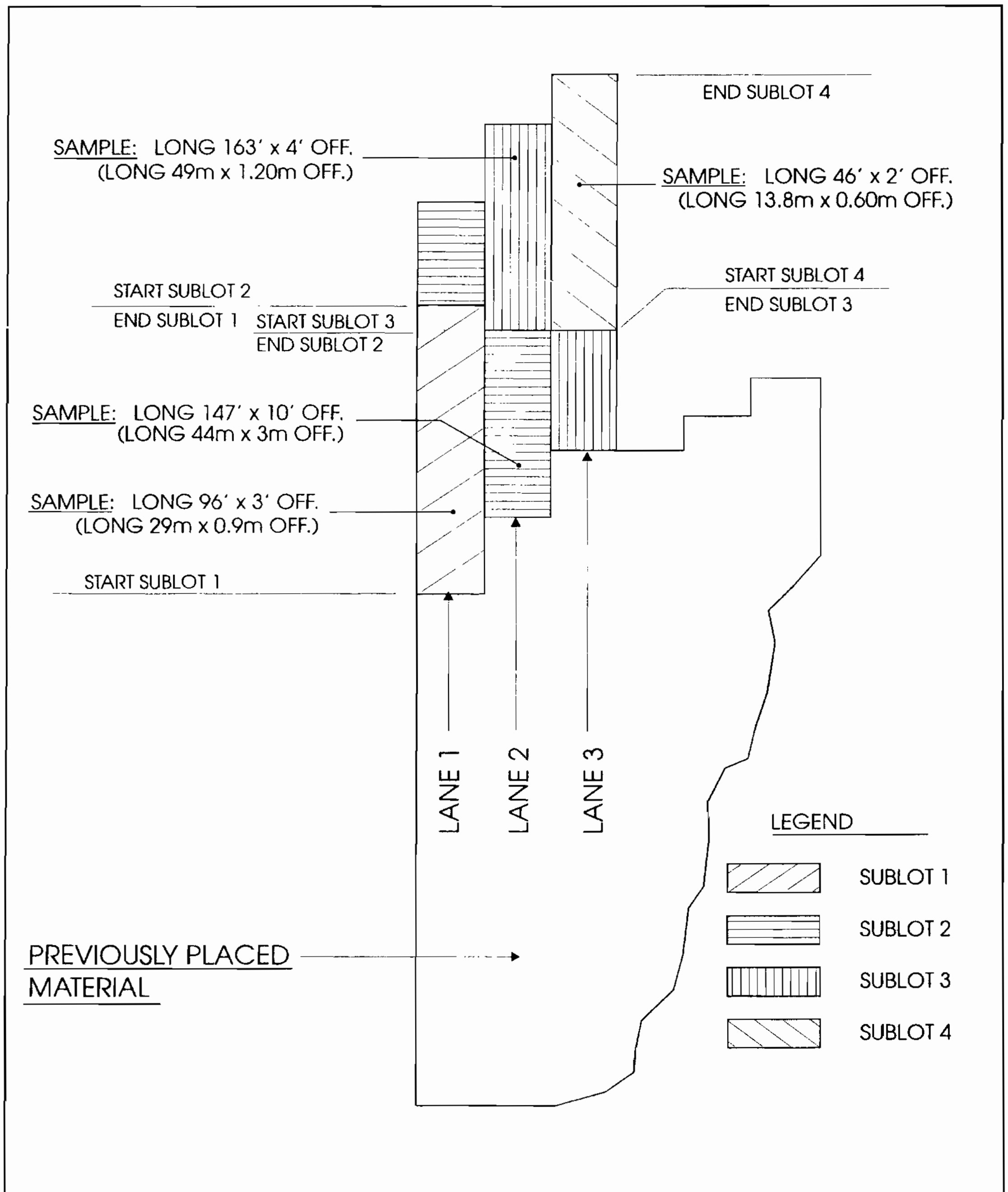


FIGURE 1
MAT DENSITY SAMPLING
N.T.S.

TABLE 1 - PART NO. 1
RANDOM NUMBERS FOR GENERAL SAMPLING PROCEDURE

Col. No. 1			Col. No. 2			Col. No. 3			Col. No. 4			Col. No. 5			Col. No. 6			Col. No. 7		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
15	.033	.576	05	.048	.879	21	.013	.220	18	.089	.716	17	.024	.863	30	.030	.901	12	.029	.386
21	.101	.300	17	.074	.156	30	.036	.853	10	.102	.330	24	.060	.032	21	.096	.198	18	.112	.284
23	.129	.916	18	.102	.191	10	.052	.746	14	.111	.925	26	.074	.639	10	.100	.161	20	.114	.848
30	.158	.434	06	.105	.257	25	.061	.954	28	.127	.840	07	.167	.512	29	.133	.388	03	.121	.656
24	.177	.397	28	.179	.447	29	.062	.507	24	.132	.271	28	.194	.776	24	.138	.062	13	.178	.640
11	.202	.271	26	.187	.844	18	.087	.887	19	.285	.899	03	.219	.166	20	.168	.564	22	.209	.421
16	.204	.012	04	.188	.482	24	.105	.849	01	.326	.037	29	.264	.284	22	.232	.953	16	.221	.311
08	.208	.418	02	.208	.577	07	.139	.159	30	.334	.938	11	.282	.262	14	.259	.217	29	.235	.356
19	.211	.798	03	.214	.402	01	.175	.641	22	.405	.295	14	.379	.994	01	.275	.195	28	.264	.941
29	.233	.070	07	.245	.080	23	.196	.873	05	.421	.282	13	.394	.405	06	.277	.475	11	.287	.199
07	.260	.073	15	.248	.831	26	.240	.981	13	.451	.212	06	.410	.157	02	.296	.497	02	.336	.992
17	.262	.308	29	.261	.087	14	.255	.374	02	.461	.023	15	.438	.700	26	.311	.144	15	.393	.488
25	.271	.180	30	.302	.883	06	.310	.043	06	.487	.539	22	.453	.635	05	.351	.141	19	.437	.655
06	.302	.672	21	.318	.088	11	.316	.653	08	.497	.396	21	.472	.824	17	.370	.811	24	.466	.773
01	.409	.406	11	.376	.936	13	.324	.585	25	.503	.893	05	.488	.118	09	.388	.484	14	.531	.014
13	.507	.693	14	.430	.814	12	.351	.275	15	.594	.603	01	.525	.222	04	.410	.073	09	.562	.678
02	.575	.654	27	.438	.676	20	.371	.535	27	.620	.894	12	.561	.980	25	.471	.530	06	.601	.675
18	.591	.318	08	.467	.205	08	.409	.495	21	.629	.841	08	.652	.508	13	.486	.779	10	.612	.859
20	.610	.821	09	.474	.138	16	.445	.740	17	.691	.583	18	.668	.271	15	.515	.867	26	.673	.112
12	.631	.597	10	.492	.474	03	.494	.929	09	.708	.689	30	.736	.634	23	.567	.798	23	.738	.770
27	.651	.281	13	.499	.892	27	.543	.387	07	.709	.012	02	.763	.253	11	.618	.502	21	.753	.614
04	.661	.953	19	.511	.520	17	.625	.171	11	.714	.049	23	.804	.140	28	.636	.148	30	.758	.851
22	.692	.089	23	.591	.770	02	.699	.073	23	.720	.695	25	.828	.425	27	.650	.741	27	.765	.563
05	.779	.346	20	.604	.730	19	.702	.934	03	.748	.413	10	.843	.627	16	.711	.508	07	.780	.534
09	.787	.173	24	.654	.330	22	.816	.802	20	.781	.603	16	.858	.849	19	.778	.812	04	.818	.187
10	.818	.837	12	.728	.523	04	.838	.166	26	.830	.384	04	.903	.327	07	.804	.675	17	.837	.353
14	.895	.631	16	.753	.344	15	.904	.116	04	.843	.002	09	.912	.382	08	.806	.952	05	.854	.818
26	.912	.376	01	.806	.134	28	.969	.742	12	.884	.582	27	.935	.162	18	.841	.414	01	.867	.133
28	.920	.163	22	.878	.884	09	.974	.046	29	.926	.700	20	.970	.582	12	.918	.114	08	.915	.538
03	.945	.140	25	.939	.162	05	.977	.494	16	.951	.601	19	.975	.327	03	.992	.399	25	.975	.584

TABLE 1 - PART NO. 2
RANDOM NUMBERS FOR GENERAL SAMPLING PROCEDURE

Col. No. 8			Col. No. 9			Col. No. 10			Col. No. 11			Col. No. 12			Col. No. 13			Col. No. 14		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
09	.042	.071	14	.061	.935	26	.038	.023	27	.074	.779	16	.073	.987	03	.033	.091	26	.035	.175
17	.141	.411	02	.065	.097	30	.066	.371	06	.084	.396	23	.078	.056	07	.047	.391	17	.089	.363
02	.143	.221	03	.094	.228	27	.073	.876	24	.098	.524	17	.096	.076	28	.064	.113	10	.149	.681
05	.162	.899	16	.122	.945	09	.095	.568	10	.133	.919	04	.153	.163	12	.066	.360	28	.238	.075
03	.285	.016	18	.158	.430	05	.180	.741	15	.187	.079	10	.254	.834	26	.076	.552	13	.244	.767
28	.291	.034	25	.193	.469	12	.200	.851	17	.227	.767	06	.284	.628	30	.087	.101	24	.262	.366
08	.369	.557	24	.224	.572	13	.259	.327	20	.236	.571	12	.305	.616	02	.127	.187	08	.264	.651
01	.436	.386	10	.225	.223	21	.264	.681	01	.245	.988	25	.319	.901	06	.144	.068	18	.285	.311
20	.450	.289	09	.233	.838	17	.283	.645	04	.317	.291	01	.320	.212	25	.202	.674	02	.340	.131
18	.455	.789	20	.290	.120	23	.363	.063	29	.350	.911	08	.416	.372	01	.247	.025	29	.353	.478
23	.488	.715	01	.297	.242	20	.364	.366	26	.380	.104	13	.432	.556	23	.253	.323	06	.359	.270
14	.496	.276	11	.337	.760	16	.395	.363	28	.425	.864	02	.489	.827	24	.320	.651	20	.387	.248
15	.503	.342	19	.389	.064	02	.423	.540	22	.487	.526	29	.503	.787	10	.328	.365	14	.392	.694
04	.515	.693	13	.411	.474	08	.432	.736	05	.552	.511	15	.518	.717	27	.338	.412	03	.408	.077
16	.532	.112	20	.447	.893	10	.476	.468	14	.564	.357	28	.524	.998	13	.356	.991	27	.440	.280
22	.557	.357	22	.478	.321	03	.508	.774	11	.572	.306	03	.542	.352	16	.401	.792	22	.461	.830
11	.559	.620	29	.481	.993	01	.601	.417	21	.594	.197	19	.585	.462	17	.423	.117	16	.527	.003
12	.650	.216	27	.562	.403	22	.687	.917	09	.607	.524	05	.695	.111	21	.481	.838	30	.531	.486
21	.672	.320	04	.566	.179	29	.697	.862	19	.650	.572	07	.733	.838	08	.560	.401	25	.678	.360
13	.709	.273	08	.603	.758	11	.701	.605	18	.664	.101	11	.744	.948	19	.564	.190	21	.725	.014
07	.745	.687	15	.632	.927	07	.728	.498	25	.674	.428	18	.793	.748	05	.571	.054	05	.797	.595
30	.780	.285	06	.707	.107	14	.745	.679	02	.697	.674	27	.802	.967	18	.587	.584	15	.801	.927
19	.845	.097	28	.737	.161	24	.819	.444	03	.767	.928	21	.826	.487	15	.604	.145	12	.836	.294
26	.846	.366	17	.846	.130	15	.840	.823	16	.809	.529	24	.835	.832	11	.641	.298	04	.854	.982
29	.861	.307	07	.874	.491	25	.863	.568	30	.838	.294	26	.855	.142	22	.672	.156	11	.884	.928
25	.906	.874	05	.880	.828	06	.878	.215	13	.845	.470	14	.861	.462	20	.674	.887	19	.886	.832
24	.919	.809	23	.931	.659	18	.930	.601	08	.855	.524	20	.874	.625	14	.752	.881	07	.929	.932
10	.952	.555	26	.960	.365	04	.954	.827	07	.867	.718	30	.929	.056	09	.774	.560	09	.932	.206
06	.961	.504	21	.978	.194	28	.963	.004	12	.881	.722	09	.936	.522	29	.921	.752	01	.970	.692
27	.969	.811	12	.982	.183	19	.988	.020	23	.937	.872	22	.947	.797	04	.959	.099	23	.973	.082

TABLE 1 - PART NO. 3
RANDOM NUMBERS FOR GENERAL SAMPLING PROCEDURE

Col. No. 15			Col. No. 16			Col. No. 17			Col. No. 18			Col. No. 19			Col. No. 20			Col. No. 21		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
15	.023	.979	19	.062	.588	13	.045	.004	25	.027	.290	12	.052	.075	20	.030	.881	01	.010	.946
11	.118	.465	25	.080	.218	18	.086	.878	06	.057	.571	30	.075	.493	12	.034	.291	10	.014	.939
07	.134	.172	09	.131	.295	26	.126	.990	26	.059	.026	28	.120	.341	22	.043	.893	09	.032	.346
01	.139	.230	18	.136	.381	12	.128	.661	07	.105	.176	27	.145	.689	28	.143	.073	06	.093	.180
16	.145	.122	05	.147	.864	30	.146	.337	18	.107	.358	02	.209	.957	03	.150	.937	15	.151	.012
20	.165	.520	12	.158	.365	05	.169	.470	22	.128	.827	26	.272	.818	04	.154	.867	16	.185	.455
06	.185	.481	28	.214	.184	21	.244	.433	23	.156	.440	22	.299	.317	19	.158	.359	07	.227	.277
09	.211	.316	14	.215	.757	23	.270	.849	15	.171	.157	18	.306	.475	29	.304	.615	02	.304	.400
14	.248	.348	13	.224	.846	25	.274	.407	08	.220	.097	20	.311	.653	06	.369	.633	30	.316	.074
25	.249	.890	15	.227	.809	10	.290	.925	20	.252	.066	15	.348	.156	18	.390	.536	18	.328	.799
13	.252	.577	11	.280	.898	01	.323	.490	04	.268	.576	16	.381	.710	17	.403	.392	20	.352	.288
30	.273	.088	01	.331	.925	24	.352	.291	14	.275	.302	01	.411	.607	23	.404	.182	26	.371	.216
18	.277	.689	10	.399	.992	15	.361	.155	11	.297	.589	13	.417	.715	01	.415	.457	19	.448	.754
22	.372	.958	30	.417	.787	29	.374	.882	01	.358	.305	21	.472	.484	07	.437	.696	13	.487	.598
10	.461	.075	08	.439	.921	08	.432	.139	09	.412	.089	04	.478	.885	24	.446	.546	12	.546	.640
28	.519	.536	20	.472	.484	04	.467	.266	16	.429	.834	25	.479	.080	26	.485	.768	24	.550	.038
17	.520	.090	24	.498	.712	22	.508	.880	10	.491	.203	11	.566	.104	15	.511	.313	03	.604	.780
03	.523	.519	04	.516	.396	27	.632	.191	28	.542	.306	10	.576	.659	10	.517	.290	22	.621	.930
26	.573	.502	03	.548	.688	16	.661	.836	12	.563	.091	29	.665	.397	30	.556	.853	21	.629	.154
19	.634	.206	23	.597	.508	19	.675	.629	02	.593	.321	19	.739	.298	25	.561	.837	11	.634	.908
24	.635	.810	21	.681	.114	14	.680	.890	30	.692	.198	14	.749	.759	09	.574	.599	05	.696	.459
21	.679	.841	02	.739	.298	28	.714	.508	19	.705	.445	08	.756	.919	13	.613	.762	23	.710	.078
27	.712	.366	29	.792	.038	06	.719	.441	24	.709	.717	07	.798	.183	11	.698	.783	29	.726	.585
05	.780	.497	22	.829	.324	09	.735	.040	13	.820	.739	23	.834	.647	14	.715	.179	17	.749	.916
23	.861	.106	17	.834	.647	17	.741	.906	05	.848	.866	06	.837	.978	15	.770	.128	04	.802	.186
12	.865	.377	16	.909	.608	11	.747	.205	27	.867	.633	03	.849	.964	08	.815	.385	14	.835	.319
29	.882	.635	06	.914	.420	20	.850	.047	03	.883	.333	24	.851	.109	05	.872	.490	08	.870	.546
08	.902	.020	27	.958	.856	02	.859	.356	17	.900	.443	05	.859	.935	21	.885	.999	28	.871	.539
04	.951	.482	26	.981	.976	07	.870	.612	21	.914	.483	17	.863	.220	02	.958	.177	25	.971	.369
02	.977	.172	07	.983	.624	03	.916	.463	29	.950	.753	09	.865	.147	27	.961	.980	27	.984	.252

TABLE 1 - PART NO. 4
RANDOM NUMBERS FOR GENERAL SAMPLING PROCEDURE

Col. No. 22			Col. No. 23			Col. No. 24			Col. No. 25			Col. No. 26			Col. No. 27			Col. No. 28		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
12	.051	.032	26	.051	.187	08	.015	.521	02	.039	.005	16	.026	.102	21	.050	.952	29	.042	.039
11	.068	.980	03	.053	.256	16	.068	.994	16	.061	.599	01	.033	.886	17	.085	.403	07	.105	.293
17	.089	.309	29	.100	.159	11	.118	.400	26	.068	.054	04	.088	.686	10	.141	.624	25	.115	.420
01	.091	.371	13	.102	.465	21	.124	.565	11	.073	.812	22	.090	.602	05	.154	.157	09	.126	.612
10	.100	.709	24	.110	.316	18	.153	.158	07	.123	.649	13	.114	.614	06	.164	.841	10	.205	.144
30	.121	.744	18	.114	.300	17	.190	.159	05	.126	.658	20	.136	.576	07	.197	.013	03	.210	.054
02	.166	.056	11	.123	.208	26	.192	.676	14	.161	.189	05	.138	.228	16	.215	.363	23	.234	.533
23	.179	.529	09	.138	.182	01	.237	.030	18	.166	.040	10	.216	.565	08	.222	.520	13	.266	.799
21	.187	.051	06	.194	.115	12	.283	.077	28	.248	.171	02	.233	.610	13	.269	.477	20	.305	.603
22	.205	.543	22	.234	.480	03	.286	.318	06	.255	.117	07	.278	.357	02	.288	.012	05	.372	.223
28	.230	.688	20	.274	.107	10	.317	.734	15	.261	.928	30	.405	.273	25	.333	.633	26	.385	.111
19	.243	.001	21	.331	.292	05	.337	.844	10	.301	.811	06	.421	.807	28	.348	.710	30	.422	.315
27	.267	.990	08	.346	.085	25	.441	.336	24	.363	.025	12	.426	.583	20	.362	.961	17	.453	.783
15	.283	.440	27	.382	.979	27	.469	.786	22	.378	.792	08	.471	.708	14	.511	.989	02	.460	.916
16	.352	.089	07	.387	.865	24	.473	.237	27	.379	.959	18	.473	.738	26	.540	.903	27	.461	.841
03	.377	.648	28	.411	.776	20	.475	.761	19	.420	.557	19	.510	.207	27	.587	.643	14	.483	.095
06	.397	.769	16	.444	.999	06	.557	.001	21	.467	.943	03	.512	.329	12	.603	.745	12	.507	.375
09	.409	.428	04	.515	.993	07	.610	.238	17	.494	.225	15	.640	.339	29	.619	.895	28	.509	.748
14	.465	.406	17	.518	.827	09	.617	.041	09	.620	.081	09	.665	.354	23	.623	.333	21	.583	.804
13	.499	.651	05	.539	.620	13	.641	.648	30	.623	.106	14	.680	.884	22	.624	.076	22	.587	.993
04	.539	.972	02	.623	.271	22	.664	.291	03	.625	.777	26	.703	.622	18	.670	.904	16	.689	.339
18	.560	.747	30	.637	.374	04	.668	.856	08	.651	.790	29	.739	.394	11	.711	.253	06	.727	.298
26	.575	.892	14	.714	.364	19	.717	.232	12	.715	.599	25	.759	.386	01	.790	.392	04	.731	.814
29	.756	.712	15	.730	.107	02	.776	.504	23	.782	.093	24	.803	.602	04	.813	.611	08	.807	.983
20	.760	.920	19	.771	.552	29	.777	.548	20	.810	.371	27	.842	.491	19	.843	.732	15	.833	.757
05	.847	.925	23	.780	.662	14	.823	.223	01	.841	.726	21	.870	.435	03	.844	.511	19	.896	.464
25	.872	.891	10	.924	.888	23	.848	.264	29	.862	.009	28	.906	.367	30	.858	.299	18	.916	.384
24	.874	.135	12	.929	.204	30	.892	.817	25	.891	.873	23	.948	.377	09	.929	.199	01	.948	.610
08	.911	.215	01	.937	.714	28	.943	.190	04	.917	.264	11	.956	.142	24	.931	.263	11	.976	.799
07	.946	.065	25	.974	.398	15	.975	.962	13	.958	.990	17	.993	.989	15	.939	.947	24	.978	.633

FIGURE 2
METHOD OF SAMPLING BITUMINOUS MIXTURES

1. SCOPE. This method of sampling covers the procedures used to sample bituminous mixtures at the plant to obtain samples for Marshall Tests and laboratory extraction tests.

2. APPARATUS. Scoop to make furrows and to dig material from the furrows in the pile of bituminous mixture.

3. PROCEDURES.

a. The samples for Extraction and Marshall testing will be taken at the plant, from trucks, by the contractor's or the Architect/ Engineer's representative, as required.

b. The following method will be used to obtain samples from the designated truckloads of material:

(1) From three of the conical piles of mixture within the truck, three furrows 3 to 6 inches (7.5 to 15 cm) in depth will be dug extending from the top to the bottom of the pile. Each furrow will follow the slope of the pile and be formed as near its center as possible. Sampling in areas between piles will be avoided because of possible segregation.

(2) Three scoops of approximately equal volumes of material will be dug from each furrow, representing the top third, center third and bottom third of the pile. The material will then be thoroughly mixed together to form one sample.

(3) Use "splitter" to quarter up sample for two extraction samples and two Marshall samples (two recheck samples).

(4) The material shall be promptly placed in sealed and insulated containers, or approved substitute. When ready for use, very carefully remove the material so as to keep the samples representative and place directly in the molds or in the extraction sample container.*

(5) All tools and containers will be kept clean to prevent the build-up of bituminous material.

(6) All samples used for acceptance testing must be identified as to the time, date and truck number from which they were taken (Plant Ticket Number).

*NOTE: The Marshall samples may be transferred to an approved sample pan and placed in the Plant Laboratory oven to maintain heat (121°F ± 3°) for no more than 30 minutes.

SECTION 9

Temperatures

1. General Information - Temperature measurements shall be made by the Contractor as part of his required Quality Control Testing and checked by the Project Testing Laboratory. The purpose of the measurements is to check the temperatures of the dryer discharge, and the mixture discharge from the pugmill or the drum discharge, the bitumen in the storage tank, the mixture in the trucks at the plant, the mixture at the spreader at the job site and the mixture of the placed asphalt during compaction work.

2. Frequency of Measurements - The frequency of the temperature measurements shall be in accordance with the requirements of Appendix I to Specifications Section P-401.

3. Equipment and Procedure - The thermometers shall be reliable and accurate instruments, appropriate as to type and sensitivity or the particular measurements required. Armored glass, dial-type with metal stem, or remote sensing element with shield and associated indicator are typical examples. Periodically they shall be properly calibrated at a minimum by comparative readings with accurate, calibrated thermometers.

4. Use of Standard Forms - Standard forms for recording the required temperature measurements are included in Appendix III-C.

JOB MIX FORMULA

DATE : . . . .

DCAD CONTRACT No.: . . . .

AIP PROJECT No. : . . . .

AIRPORT NAME : . . . .

AIRPORT LOCATION : . . . .

CONTRACTOR :

Name : . . . .

Location : . . . .

ASPHALTIC CONCRETE PLANT :

Name : . . . .

Location : . . . .

Type : . . . .

Capacity : . . . .

PREPARED BY :

Name : . . . .

Location : . . . .

SPECIFICATION : . . . .

ARCHITECT/ENGINEER :

Name : . . . .

JOBMIX CDR

DCAD CONTRACT NO. ______________________________

AIP PROJECT NO. __________________________________ SPEC. ____________________

PRODUCER: ______________________________________ DATE: ____________________

INITIAL MATERIAL ACCEPTANCE TESTING

PROPERTY	TEST	VALUE	SPECIFICATION
COARSE AGGREGATE: Wear-Abrasion	ASTM C 131		Wear ≤ 40%
Soundness - Sodium Sulfate Soundness - Magnesium Sulfate	ASTM C 88 ASTM C 88		After 5 cycles Loss < 9% Loss ≤ 12%
Flat and Elongated Pieces	Appendix III E ASTM D 4791		< 8%
Crushed Pieces	P-401-2.1-(a)		Fractured Faces (by Wt.) 2 or more > 75% 1 or more > 85%
FINE AGGREGATE: Plasticity Index	ASTM D 4318 (Mod. DCAD T-611)		Non-Plastic
Liquid Limit	ASTM D 4318 (Mod. DCAD T-611)		≤ 15
Dust (-200 fraction)	ASTM C 117 (Procedure "B")		2% to 6%
Bulk Specific Gravity Coarse Aggregate Blend Fine	ASTM C-127 ASTM C-128		

NOTES:
Asphalt Absorption Values of Aggregate Blend: ASTM D-2041 (%) ____________________

USCE EM-1110-45-302 (%) ____________

SIGNED: ______________________________

AFFILIATION: ___________________________

DCAD CONTRACT NO.: ____

AIP PROJECT NO.: ____

PRODUCER: ____

SIGNED: ______________________ AFFILIATION: ______________________

DATE: ______________

AGGREGATE PROPERTIES

Material	Source	Percent Used in Final Aggregate Blend

ASPHALT CEMENT (AC) PROPERTIES

Material	Source	Spec. Gravity

ASTM D 2041: OPTIMUM AC - MAX SPECIFIC GRAVITY OF MIX = ______________

JOB MIX FORMULA GRADATION

DCAD CONT No. : ____________

AIP PROJECT No. ____________

PRODUCER : ____________

SPEC. : ____________

DATE : ____________

SIEVE SIZE	BIN NO. 5 ____%		BIN NO. 4 ____%		BIN NO. 3 ____%		BIN NO. 2 ____%		BIN NO. 1 ____%		COMB. GRAD.	JMF GRAD.	JMF RANGE		GEN'L SPEC.	
	% Pass	% Batch	% Pass	% Batch	% Pass	% Batch	% Pass	% Batch	% Pass	% Batch	% Pass	% Pass	Min.	Max.	Min.	Max.

JOBMIXFO.CDR

NOTE :

THE MATERIALS REPORTED ABOVE WERE SAMPLED FROM HOT BINS (BATCH PLANT) ____________ ____________

FROM THE COLD BINS (DRUM PLANT) ____________ ____________

YES NO

COLD FEED	
BIN No.	SETTING
1	
2	
3	
4	
5	

SIGNED : ____________ AFFILIATION : ____________

DCAD CONTRACT NO.: ______________________________

AIP PROJECT NO.: ______________________________

PRODUCER: ______________________________

SIGNED: ______________ AFFILIATION: ______________

DATE: ______________

No.

Lab. No.
Order No.

REPORT OF:

JOB MIX FORMULA COMPLIANCE TEST
(5000 TON PLANT PRODUCTION)
(Not Less Than Weekly)

BULK SPECIFIC GRAVITY ASTM C 127 & C 128					BULK SPECIFIC GRAVITY AGGREGATE BLEND
Aggregate #1	Aggregate #2	Aggregate #3	Aggregate #4	Aggregate #5	
%	%	%	%	%	100%

Formula: Bulk Specific Gravity Aggregate Blend

$$G_{sb} = \frac{P_1 + P_2 + \ldots + P_n}{\frac{P_1}{G_1} + \frac{P_2}{G_2} + \ldots \frac{P_n}{G_n}}$$

G_{sb} = bulk specific gravity total aggregate blend

P_1, P_2, P_n = percentages by weight of aggregates, 1, 2, n

G_1, G_2, G_n = bulk specific gravities of aggregates, 1, 2, n

G_1, G_2, G_n = bulk specific gravity of aggregates 1, 2, n

DCAD CONT No. : ____________________

AIP PROJECT No. ____________________

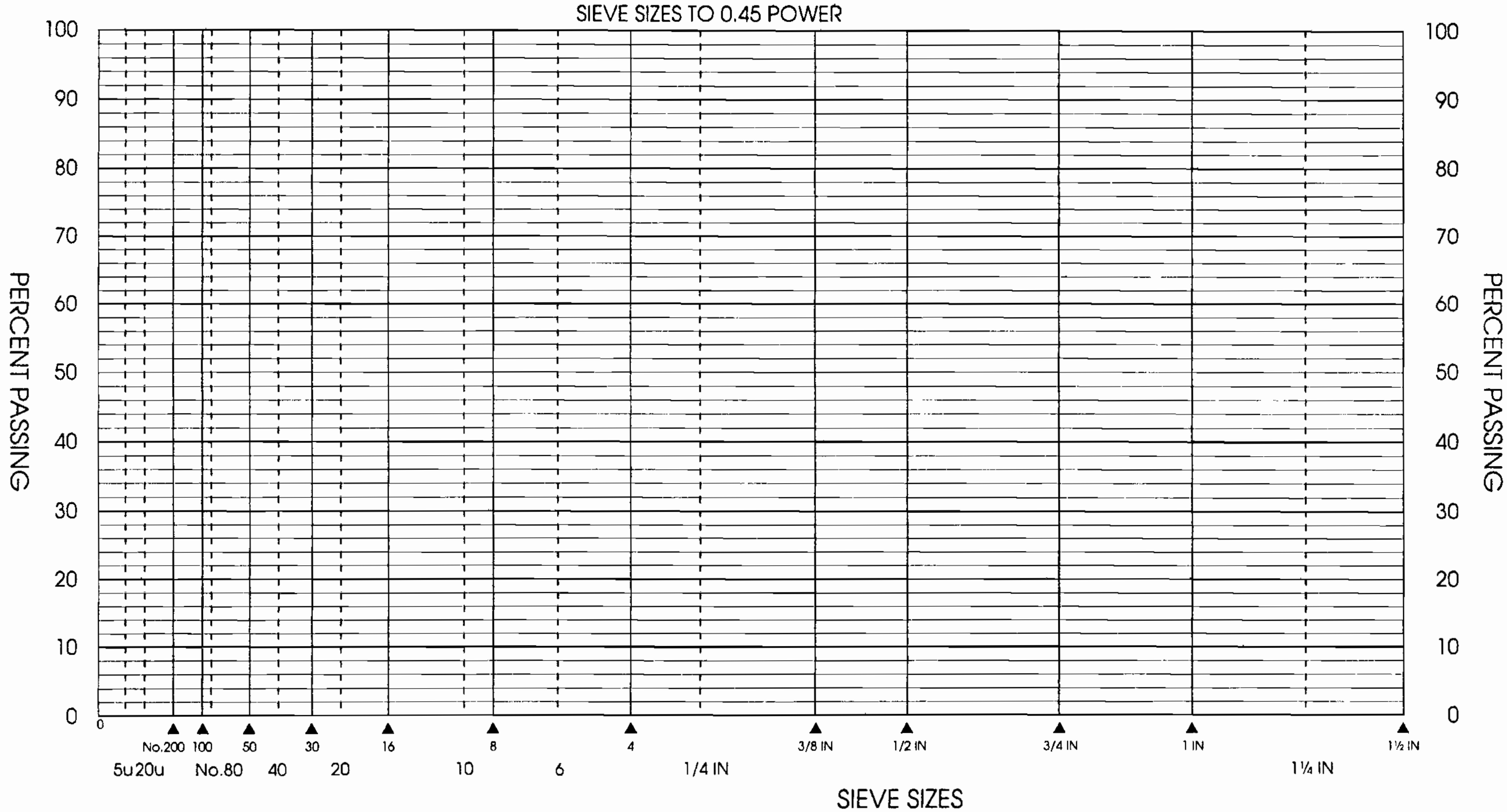
PRODUCER : ____________________

LOCATION : ____________________

DATE : __________ SPEC. : __________

UNITED STATES BUREAU OF PUBLIC ROADS 0.45 POWER GRADATION CHART

SIEVE SIZES TO 0.45 POWER



▲ THIS SYMBOL IDENTIFIES SIMPLIFIED PRACTICE AND COMPATIBLE SIEVE SIZES

Identification of Gradation :

Sheet No.

Date

SIGNED : ____________________ AFFILATION : ____________________

POWERCHT.CDR

WP217A/006

BITUMINOUS CONCRETE TESTING REPORT

DCAD CONT No. ____________________

AIP PROJECT No. ____________________ DATE : ____________

PRODUCER : ____________________ SPEC. . ____________

COMPUTATION OF MARSHALL MIX PROPERTIES

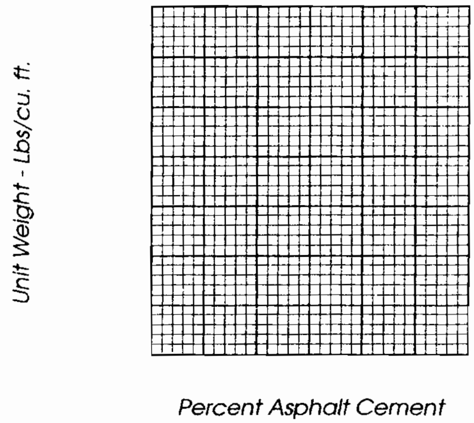
SPECI-MEN No.	BULK SP. GRAVITY AGGREGATE BLEND	ASPHALT CONTENT PERCENT	THICK-NESS INCHES	WGT. - GRAMS			VOLUME CC	SP. GRAVITY		AC BY VOL %	VOIDS %			UNIT WGT. TOTAL MIX LB/CU FT.	STABILITY-LB		FLOW UNITS OF 1/100 IN.
				IN AIR	IN WATER	SAT. SURF DRY		ACT	THEOR. Gmm		TOTAL MIX	MIN. AGG. VMA	FILLED VF		MEASURED	CONVERTED	
	A	B	C	D	E	E'	F	G	H	I	J	K	L	M	N	O	P
							(E'-E)	(D)/(F)	(RICE'S)	(BxG). SP. GR. OF AC	100 - 100 G/H	100- G x (100-B)/A	K-J/K	62.4 G			
AVG.																	
AVG.																	
AVG.																	
AVG.																	

BITUMIN.CDR

SIGNED : ____________________ AFFILIATION : ____________________

WP217A/006

(a)



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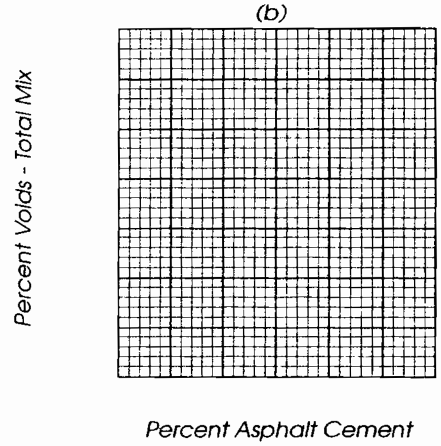

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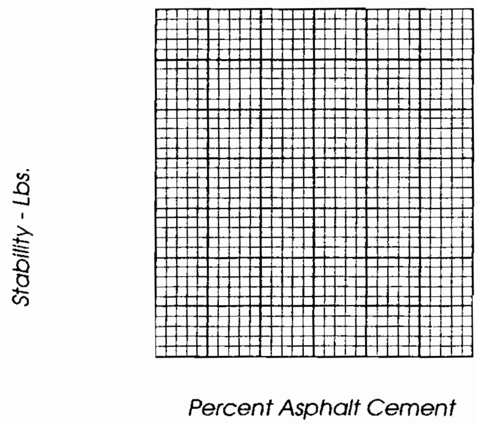

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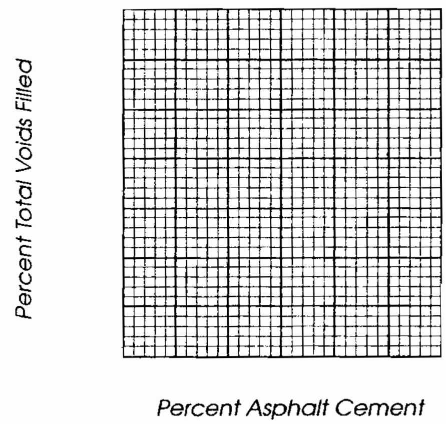
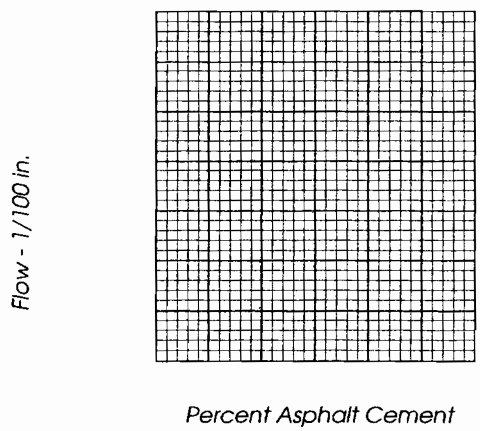
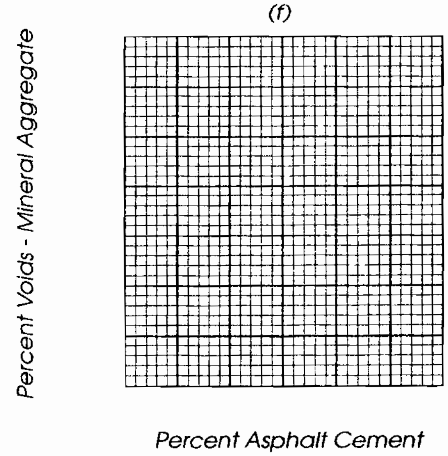


(e)



(f)



SIGNED : ____________________

AFFILIATION : ____________________

DATE : ____________________

DACD CONT. No. ____________________

DCAD CONTRACT NO.: ________________ DATE: ____________________________

AIP PROJECT NO.: _____________________ SIGNED: __________________________

PRODUCER: __________________________ AFFILIATION: ____________________

JMF TEST PROPERTIES AT OPTIMUM ASPHALT CONTENT

Property	Value	Specifications
Mixing Temp, °F (°C)		Temperature/* Viscosity Chart
Compaction Temp, °F (°C)		250° ± 5° F (121° ± 3°C)
Compactive Effort: No. of Blows	75	75
Asphalt Content, %		6.5 - 8.5
Marshall Stability, lbs. (Newtons), min.		2150 (9555)
Flow Value, 0.01 in. (0.25mm)		9 - 14
Air Voids, % (Design Target)	(4.0)	3 - 5
Voids Mineral Aggregate, %		1/2" (12.5mm) Mix - 16% Min. 3/4" (19.0mm) Mix - 15% Min. 1" (25mm) Mix - 14% Min.
Unit Weight, 1bs/ft^3 (kgs/cu. meter)		----
Specific Gravities: Maximum Theoretical "Rice's" ASTM D 2041 Bulk-Stockpiles ASTM C 127 & C 128		 ---- ----
USCE-EM-1110-45-302		----
Tensile Strength Ratio Test, % (ASTM D-4867)		75% Min.
Index of Retained Stability Test, % (ASTM D-1075)		75% Min.

NOTES:

* Value to be obtained from current chart supplied by the Bituminous Material supplier.

MEASUREMENT OF REDUCTION IN MARSHALL STABILITY OF BITUMINOUS PAVEMENTS CAUSED BY IMMERSION IN WATER[1]

1. SCOPE

1.1 This test method is intended to measure the reduction in Marshall stability resulting from the action of water on compacted bituminous mixtures containing penetration grade asphalt, tar, or rubberized tar. A numerical index of reduced stability is obtained by comparing the stability of specimens determined in accordance with usual Marshall procedures with the stability of specimens that have been immersed in water for a prescribed period.

2. APPARATUS

2.1 Water bath. A water bath at least 6 inches deep provided with mechanical water agitator, heating elements, and thermostatic controls capable of maintaining the bath water at temperatures ranging from 100° to 140°F (38° to 60°C). The bath shall have a perforated false bottom or be equipped with a shelf for supporting specimens 2 inches above the bottom of the bath.

2.2 Balance and water container with accessory equipment for weighing the test specimens in air and in water.

2.3 Transfer plates, flat, of glass or metal. One of these plates shall be kept under each test specimen during immersion and subsequent handling, except when weighing and testing, in order to prevent breakage or distortion of the specimens.

3. SPECIMENS

3.1 A minimum of eight standard marshall test specimens, 4 in. (100mm) in diameter and 2 1/2 (62.5mm) inches ± 1/8 in. (±3mm) in height, shall be prepared for each test in accordance with the procedures described in Section 3.

4. PROCEDURE

4.1 Weigh each test specimen in air and in water.

4.2 Calculate the specific gravity of each test specimen as follows:

$$\text{Specific gravity} = \frac{A}{A - B}$$

where

A = weight of specimen in air, g

B = weight of specimen in water, g

4.3 Sort the test specimens into two groups so that the average specific gravity of the specimens in group 1 is essentially the same as that of group 2.

4.4 Test the specimens in group 1 for Marshall stability and flow as described in Section 3.

4.5 Immerse the group 2 specimens in water for 24 hours at the temperatures specified in the following tabulation.

4.6 Test immediately upon removal from the water for stability and flow as described in Section 3.

Type bituminous material	Marshall stability test water temperature
Asphalt Cement ________	140 ± 1°F (60° ± 0.5°C)

5. CALCULATION

5.1 The numerical index of resistance of bituminous mixtures to the detrimental effect of water shall be expressed as a percentage of the original stability as follows:

Index of retained stability =
$(S_2 \div S_1) \times 100$

Where
S_1 = Marshall stability of group 1 (average)

S_2 = Marshall stability of group 2 (average)

---

[1]This method is based in part on ASTM D 1075, Standard Method of Test for Effect of Water on Cohesion of Compacted Bituminous Mixture.

DCAD CONTRACT NO. ____________________ DATE: ________________________________

AIP PROJECT NO. ______________________ SIGNED: ______________________________

PRODUCER: ____________________________ AFFILIATION: _________________________

DETERMINATION OF OPTIMUM ASPHALT CONTENT (AC)

JMF DATA

% AC	Actual S.G.	Max. S.G.	Unit Weight	Stability	Flow	% Air Voids	% VMA
6.5							
6.75							
7.0							
7.25							
7.5							

Specification

% Asphalt Cement (AC)

JMF Requirements

Stability	____ min.
Flow	____ min. - ____ max.
% Air Voids	Target 4.0 (min. 3.0, max. 5.0)
% Voids Mineral Aggregate	(1/2" (12.5 mm) Mix min. 16 3/4" (19.0 mm) Mix min. 15 1" (25.0 mm) Mix min. 14)
Unit Weight	± 1.5 lbs.

Determine % AC at midpoint of % voids specifications parameter.

From graph - @ ___ % Air voids AC is approx. ____%

Check the other specification parameters to insure that they are all well within the JMF Specification limits.

SAMPLE

DETERMINATION OF OPTIMUM ASPHALT CONTENT - EXAMPLE
JMF DATA

% AC	Actual S.G.	Max S.G.	Unit Weight Lbs./CF	Stability Pounds	Flow	% Air Voids	% VMA*	% VF	Unit Weight kgs/m^3	Stability Newton
6.5	2.175	2.303	135.7	2775	10	5.6	17.00	67.01	2174	12344
7.0	2.193	2.289	136.8	2970	10.8	4.2	16.76	74.94	2191	13211
7.5	2.207	2.285	137.7	3000	12	3.4	16.67	79.54	2206	13344
8.0	2.195	2.258	137.3	2850	14	2.8	17.58	84.07	2200	12677
7.4	2.205	2.286	137.5	3020	11.7	3.5	16.66	78.75	2203	13434

* Bulk S.G. Aggregate Blend - 2.450

Specification

% Asphalt Cement (AC)	6.5 - 8.5
JMF Requirements	
Stability - 1 lbs. (Newtons), min.	2,150 (9,555)
Flow	9-14
% Air Voids	Target 4.0 (min. 3.0, max. 5.0)
% Voids Mineral Aggregate	1/2" (12.5 mm) Mix min. 16 3/4" (19.0 mm) Mix min. 15 1" (25.0 mm) Mix min. 14
Unit Weight	± 1.5 lbs.

Determine % AC at midpoint of % voids specifications parameter.

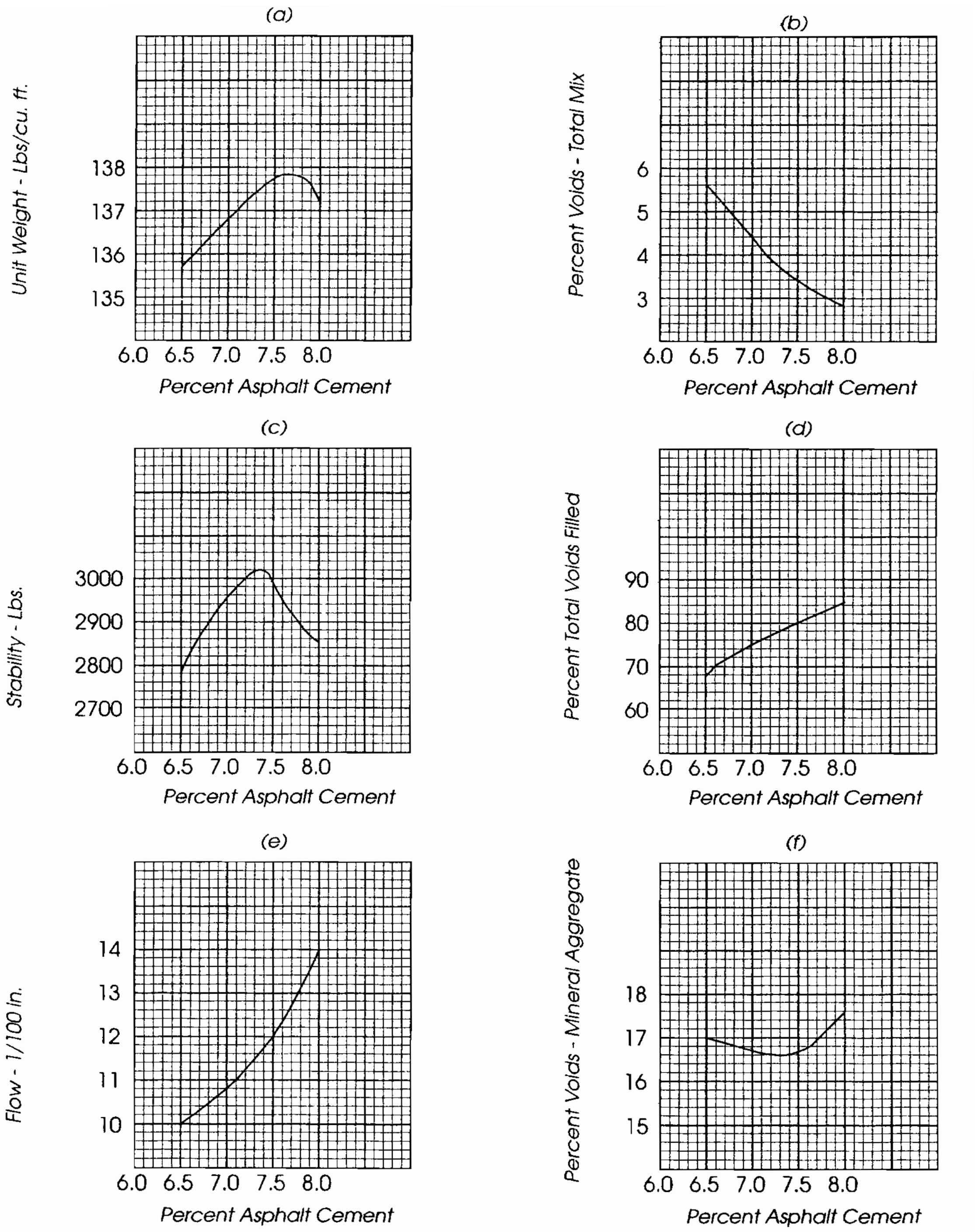
From graph - @ 4.0% Air voids AC is approx. 7.2%

A check of the other specification parameters at this AC content reveals that they are all well within the JMF specification limits.

Conclusion - Establish JMF Asphalt Cement (AC) content at 7.2% ± 0.15% (Action Limit) ± 0.25 (Suspension Limit)

NOTE 1: Every effort should be made to establish plant production at the 7.2% level. The ± 0.15 tolerance is provided to allow for normal variations in plant production and testing variability. Under no circumstances should the contractor attempt to produce with the AC content at the extremities of the ± 0.15 tolerance limits, since by doing so, his chance of complying with the Marshall acceptance criteria will be greatly reduced.

NOTE 2: The calculated Asphalt Cement Content for 10 batches or a truckload of plant hot mix materials determined by using the Plant tickets, should never vary more than ± 0.1% from the JMF AC content unless something is wrong with the Plant asphalt cement metering/weighing system.



SIGNED : ______________________

AFFILIATION : ______________________

DATE : ______________________

DACD CONT. No. ______________________

BIN GRADATION ANALYSIS

DCAD CONT No. : ______________________

AIP PROJECT No. ______________________

PRODUCER : ______________________

SPEC. : ______________________

DATE : ______________________

SIEVE SIZE	BIN N0. 5 ______%		BIN N0. 4 ______%		BIN N0. 3 ______%		BIN N0. 2 ______%		BIN N0. 1 ______%		COMB H_20 %	COMB GRAD.	JMF RANGE		GEN'L SPEC.	
	% Pass	% Batch	% Pass	% Batch	% Pass	% Batch	% Pass	% Batch	% Pass	% Batch			Min.	Max.	Min.	Max.

BIN_GRAD.CDR

JMF SPEC. GRAVITY : ______________________

MEASURED SPEC. GRAVITY : ______________________

TEST PERFORMED BY : ______________________

SIGNED : ______________________ AFFILIATION : ______________________

DCAD CONTRACT NO. ______________________________

AIP PROJECT NO. ______________________________ SPEC.: AASHTO T-30 __________

PRODUCER: ______________________________ DATE: ______________

TEST PERFORMED BY: ______________________ AFFILIATION: ______________

EXTRACTION TEST

1. WGT. OF SAMPLE: .... W_1 =_____ gms

2. WGT. OF WATER IN SAMPLE: .... W_2= _____ gms

3. WGT. OF EXTRACTED AGGREGATE: .... W_3= _____ gms

NOTE:

ADD THE INCREASE IN WGT.
OF FILTER RING TO W_3

4. WGT. OF ASH IN EXTRACT: .... W_4= _____ gms

5. BITUMEN CONTENT OF DRY SAMPLE, %:

$$\% \text{ AC} = \frac{(W_1 - W_2)-(W_3+W_4)}{W_1-W_2} \times 100$$

% AC = ________________ x 100 = ________________ %

6. GRADATION:

SIEVE												
RET. WGT.												
% RETAINED												
% PASSING												
SPECIFICATION												

DCAD CONT No. : ____________________

AIP PROJECT No. : ____________________ SPEC : ____________________

PRODUCER : ____________________ DATE : ____________________

PERFORMED BY : ____________________ AFFILIATION : ____________________

DAILY TEMPERATURE MEASUREMENTS, °F (°C)

LOCATION	No. 1 TIME :	No. 2 TIME :	No. 3 TIME :	No. 4 TIME :	No. 5 TIME :	No. 6 TIME :
BITUMEN IN STORAGE TANK						
MIX IN TRUCKS *						
PUGMILL OR DRUM DISCHARGE						
LAYDOWN (SPREADER) *						

*LAYDOWN TESTED FROM SAME TRUCK WITH MARKED TICKET FROM PLANT.

DAILYTEM.CDR

BITUMINOUS CONCRETE TESTING REPORT

DCAD CONT No. ____________________

AIP PROJECT No. ____________________ DATE : ____________

PRODUCER : ____________________ SPEC. : ____________

COMPUTATION OF MARSHALL MIX PROPERTIES

SPECI-MEN No.	BULK SP. GRAVITY AGGREGATE BLEND	ASPHALT CONTENT PERCENT	THICK-NESS INCHES	WGT. - GRAMS			VOLUME CC	SP. GRAVITY		AC BY VOL %	VOIDS %			UNIT WGT. TOTAL MIX LB/CU FT.	STABILITY-LB		FLOW UNITS OF 1/100 IN.
				IN AIR	IN WATER	SAT. SURF DRY		ACT	THEOR. Gmm		TOTAL MIX	MIN. AGG. VMA	FILLED VF		MEASURED	CONVERTED	
	A	B	C	D	E	E'	F	G	H	I	J	K	L	M	N	O	P
							(E'-E)	$\frac{(D)}{(F)}$	(RICE'S)	(BxG), SP. GR. OF AC	$100 - \frac{100\,G}{H}$	$100 - \frac{G \times (100-B)}{A}$	$\frac{K-J}{K}$	62.4 G			
SUBLOT No. ____																	
AVG.																	
SUBLOT No. ____																	
AVG.																	
SUBLOT No. ____																	
AVG.																	
SUBLOT No. ____																	
AVG.																	

BITUMI1.CDR

SIGNED : ____________________ AFFILIATION : ____________________

DCAD CONTRACT NO.____________________ DATE: ______________________________

AIP PROJECT NO.____________________ SIGNED: ______________________________

PRODUCER: ____________________________ AFFILIATION: ______________________________

SUMMARY SHEET - MARSHALL TESTS

	STABILITY	FLOW	AIR VOIDS	VOIDS MIN. AGG.	UNIT WEIGHT
SUBLOT 1 SPECIMEN NO. 1-1					
SPECIMEN NO. 1-2					
SPECIMEN NO. 1-3					
SPECIMEN NO. 1-4					
SAMPLE INCREMENT (AVERAGE)					
SUBLOT 2 SPECIMEN NO. 2-1					
SPECIMEN NO. 2-2					
SPECIMEN NO. 2-3					
SPECIMEN NO. 2-4					
SAMPLE INCREMENT (AVERAGE)					
SUBLOT 3 SPECIMEN NO. 3-1					
SPECIMEN NO. 3-2					
SPECIMEN NO. 3-3					
SPECIMEN NO 3-4					
SAMPLE INCREMENT (AVERAGE)					
SUBLOT 4 SPECIMEN NO. 4-1					
SPECIMEN NO. 4-2					
SPECIMEN NO. 4-3					
SPECIMEN NO. 4-4					
SAMPLE INCREMENT (AVERAGE)					

DCAD CONTRACT NO. ____________________ DATE: ___________________________

AIP PROJECT NO.: _____________________ SIGNED: _________________________

PRODUCER: ____________________________ AFFILIATION: ____________________

DENSITY ACCEPTANCE CALCULATION

Percent Within Limits (PWL)			
Sublot 1 (%)	Compaction	=	*
Sublot 2 (%)	Compaction	=	*
Sublot 3 (%)	Compaction	=	*
Sublot 4 (%)	Compaction	=	*
Sublot 5 (%)	Compaction	=	*
Sublot 6 (%)	Compaction	=	*
X	(Average Lot Density)	=	*
S_n (Std. Deviation)		=	**
L (Lower Limit)		=	96.3
Q (Quality Index)	= $\frac{X-L}{S_n}$	=	
PWL (Section 01426)		=	%
Payment (Table 6 of P-401)		=	%

* To nearest tenth (1 decimal place)
** To nearest hundredth (2 decimal places)

DCAD CONT No. ____________ DATE : ____________

AIP PROJECT No. ____________ CALCULATIONS BY : ____________

PRODUCER : ____________ AFFILIATION : ____________

BULK SPECIFIC GRAVITY OF COMPACTED MIXTURE

ASTM D 2726

CORE NO.	WEIGHT - GRAMS			VOLUME CU. CM.	SPECIFIC GRAVITY Gmb
	IN AIR	IN WATER	SAT. - SURF. DRY		
SUBLOT No. ___	D	E	E^1	$(E^1\text{-}E)$ F	D/F G
1					
2					
3					
4					
5 (Optional)					
6 (Optional)					

BULKSPGR.CDR

METHOD OF TEST FOR FLAT AND ENLONGATED
PARTICLES IN COARSE AGGREGATE

SCOPE

1. This method of test outlines procedures for the determination of flat and elongated particles in coarse aggregate for concrete.

2. (a) Flat Particle - A flat particle is one having a ratio of width to thickness greater than five (Note).

(b) Elongated Particle - An elongated particle is one having a ratio of length to width greater than five (Note).

Note - Length (L), width (W), and thickness (T) are, respectively, the greatest, intermediate, and least dimensions of any particle, as measured along mutually perpendicular directions.

Apparatus

3. (a) The apparatus used in this test shall consist of any suitable equipment, by means of which aggregate particles may be tested for compliance with the definitions given in Sec. 2 above. One type of apparatus is described below.

(b) Proportional Caliper Device - The proportional caliper device consists of a base with two fixed posts and a swinging arm between them. The axis (thumbscrew) on which the arm swings is positioned so that the openings between the ends of the arms and the fixed posts maintain a constant ratio. The model described has three axis positions, by the use of which openings in the ratios of 1:2, 1:3, and 1:5, respectively, may be obtained.

(c) Balance - A balance or scales sensitive to 0.5 percent of the weight of the sample to be weighed (Note).

Procedure

4. (a) A representative sample of the supply of each size of coarse aggregate to be tested shall be selected, sieved, and reduced by quartering and/or splitting until approximately 100 particles are obtained of each sieve size larger than the 3/8-in. (9.5 mm) sieve present in the amount of 10 percent or more of the sample.

(b) Each of the particles in the sieve-size sample shall be tested, using the testing device, and segregated into one of three groups: (1) Flat, (2) Elongated, (3) Not flat or elongated.

(c) The specific procedure for use with the proportional caliper device shall be as follows:

(1) Test the Elongation - Set the larger opening equal to the length of the particle. If the width of the particle can be placed within the smaller opening, the particle is elongated.

(2) Test for Flatness - Set the larger opening equal to the width of the particle. If the thickness of the particle can be placed within the smaller opening, the particle is flat.

(d) When the particle in the sample have been classified into groups listed in subparagraph (b) above, the portion of the sample in each group shall be determined by weight.

Calculation

5. (a) The results of the test shall be calculated as indicated in the following example. Results in percent shall be reported to the nearest 1.0 percent. When weighed averages are calculated, based on actual or assumed proportions of the several sieve sizes in a size range, sieve sizes not tested shall be assumed to have the same percentages of flat and elongated particles as the average of the next smaller and the next larger sizes, or, if one of these sizes is absent, it shall be considered to have the same percentage as the next larger or next smaller size, whichever is present. Gradations used for calculating weighed averages shall be computed omitting material finer than the 3/8-in. sieve.

(b) The example on page 3 represents the complete calculations required.

Report

6. (a) The report shall include: (1) Adequate identification of the coarse aggregate tested. (2) Percentages, given to the nearest 1.0 percent, for (a) Flat particles, (b) Elongated particles, (c) Total flat and elongated particles; in each sieve size tested, calculated by weight or by number or both. (3) The number of particles of each sieve size tested. (4) Weighted average percentages based on the actual or assumed proportions of the several sieve sizes in a size range.

TEST FOR FLAT & ELONGATED PARTICLES

SIEVE IN. (mm)	GRADING, IND. % RETAINED		MATERIAL TESTED		RESULTS OF TEST BY WEIGHT						WEIGHTED AVERAGE PERCENTAGES			TOTAL FLAT OR ELONGATED PERCENT	
	SAM - PLE AS REC'D FOR TEST	CALCULATED ON PORTION RETAINED ON 3/8 IN. (9.5)	WT. G	No. of PARTICLES	FLAT		ELONGATED		NOT FLAT OR ELONGATED		FLAT	ELON- GATED	NOT FLAT OR ELONGATED	BY SIZES	WEIGHTED AVG
					G	%	G	%	G	%	BY WT.	BY WT.	BY WT.	BY WT.	BY WT.
1 (25)	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
3/4 (19)	5	8.8*	-	-	-	(49.4)	-	(3.8)	-	(46.8)	4	0	5	-	4
1/2 (12.5)	28	49.1	485	100	239.8	49.4	18.4	3.8	226.8	46.8	24	2	23	53	26
3/8 (9.5)	24	42.1	628	300	320.8	51.1	134.5	21.4	172.7	27.5	21	9	12	72	30
No. 4 (4.75)	40	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
No. 8 (2.36)	3	0.0*	-	-	-	-	-	-	-	-	-	-	-	-	-
	100	100.0													60

TEST_A.CDR

* This size not tested since it included less than 10 percent of the sample, assumed to have the same percentages of flat and elongated particles as next smaller size, as is indicated by values in parenthesies.

TEST FOR FLAT & ELONGATED PARTICLES

SIEVE IN. (mm)	GRADING, IND. % RETAINED		MATERIAL TESTED		RESULTS OF TEST BY WEIGHT						WEIGHTED AVERAGE PERCENTAGES			TOTAL FLAT OR ELONGATED PERCENT	
	SAM - PLE AS REC'D FOR TEST	CALCULATED ON PORTION RETAINED ON 3/8 IN. (9.5)	WT. G	No. of PARTICLES	FLAT		ELONGATED		NOT FLAT OR ELONGATED		FLAT	ELON- GATED	NOT FLAT OR ELONGATED	BY SIZES	WEIGHTED AVG
					G	%	G	%	G	%	BY WT.	BY WT.	BY WT.	BY WT.	BY WT.
1 (25)															
3/4 (19)															
1/2 (12.5)															
3/8 (9.5)															
No. 4 (4.75)															
No. 8 (2.36)															
	100	100.0													

TEST.CDR

DCAD CONT No. ____________________ DATE:_

AIP PROJECT No. ____________________ SIGNED: ____

PRODUCER: ____________________ AFFILIATION: ______

MAXIMUM THEORETICAL SPECIFIC GRAVITY OF BITUMINOUS PAVING MIXTURES

ASTM D 2041 (Rices Method)

A	=	weight of dry sample in air (grams)
D	=	weight of flask filled with air less water at 25°C (77°F) (grams)
E	=	weight of flask filled with water and sample at 25°C (77°F) (grams)
B	=	weight of saturated surface dry sample in air (grams)
G_{mm}	=	maximum specific gravity of mixture

$$G_{mm} = \frac{A}{B+D-E}$$

TEST NO. 1		TEST NO. 2		TEST NO. 3		TEST NO. 4 (OPTIONAL)	
A	= _______ grams	A	= _______ grams	A	= _______ grams	A	= _______ grams
D	= _______ grams	D	= _______ grams	D	= _______ grams	D	= _______ grams
B	= _______ grams	B	= _______ grams	B	= _______ grams	B	= _______ grams
E	= _______ grams	E	= _______ grams	E	= _______ grams	E	= _______ grams
G_{mm}	= _______ grams	G_{mm}	= _______ grams	G_{mm}	= _______ grams	G_{mm}	= _______ grams
G_{mm}	= _______ grams	G_{mm}	= _______ grams	G_{mm}	= _______ grams	G_{mm}	= _______ grams

Average G_{mm} =

NOTE: All aggregates shall be heated and dried in the Asphalt Plant Dryer before being used for these tests.

DCAD CONTRACT NO. ____________________ DATE: ____________________

AIP PROJECT NO. ____________________ SIGNED: ____________________

PRODUCER: ____________________ AFFILIATION: ______________

MEASURED SPECIFIC GRAVITY OF BITUMINOUS PAVING MIXTURES
ASTM D 2041 (Rice's Method)

SAMPLE 1

A.C.% ________________

Wt. of Flask + Sample	____________	
Wt. of Flask	____________	
Wt. of Sample	____________	(A)
Wt. of Flask + Water	____________	(D)
Wt. of Flask + Water + Sample	____________	(E)
Wt. of Sample Surface Dry	____________	(B)

$$\text{Sp. Gr.}[G_{mm}\text{-}1] = \frac{A}{B+D-E} + \underline{\qquad\qquad} = \frac{Wt.}{Vol.} = \underline{\qquad}$$

SAMPLE 2

A.C.% ________________

Wt. of Flask + Sample	____________	
Wt. of Flask	____________	
Wt. of Sample	____________	(A)
Wt. of Flask + Water	____________	(D)
Wt. of Flask + Water + Sample	____________	(E)
Wt. of Sample Surface Dry	____________	(B)

$$\text{Sp. Gr.}[G_{mm}\text{-}2] = \frac{A}{B+D-E} + \underline{\qquad\qquad} = \frac{Wt.}{Vol.} = \underline{\qquad\qquad}$$

SAMPLE 3

A.C.% ________________

Wt. of Flask + Sample	____________	
Wt. of Flask	____________	
Wt. of Sample	____________	(A)
Wt. of Flask + Water	____________	(D)
Wt. of Flask + Water + Sample	____________	(E)
Wt. of Sample Surface Dry	____________	(B)

$$\text{Sp. Gr.}[G_{mm}\text{-}3] = \frac{A}{B+D-E} + \underline{\qquad\qquad} = \frac{Wt.}{Vol.} = \underline{\qquad\qquad}$$

$$\text{Average } G_{mm} = \frac{(G_{mm}\text{-}1) + (G_{mm}\text{-}2) + (G_{mm}\text{-}3)}{3}$$

$$\text{Average } G_{mm} = \frac{(\qquad) + (\qquad) + (\qquad)}{3} = \underline{\qquad\qquad}$$

DCAD CONTRACT NO. ____________________ DATE: ____________________

AIP PROJECT NO. ____________________ SIGNED: ____________________

PRODUCER: ____________________ AFFILIATION: ____________________

BULK IMPREGNATED SPECIFIC GRAVITY (BISG)
U.S. CORPS OF ENGINEERS PROCEDURE,
EM-1110-45-302 APPENDIX V

A = Weight of oven dry aggregate (Hot Bin or Hot Drum Samples)
B = Weight of AC & pail & stirrer in air
C = Weight of AC & pail & stirrer in water
D = Weight of sample & AC & pail & stirrer in air
E = Weight of sample & AC & pail & stirrer in water

$$\text{BISG} = \frac{A}{(D-E)-(B-C)}$$

SAMPLE 1

Material - ________ " (Nominal Max. Size)

A=________
B=________
C=________
D=________
E=________

BISG-1 = ________

Material - ________ " (Nominal Max. Size)

A=________
B=________
C=________
D=________
E=________

BISG-2 = ________

Material - ________ " (Nominal Max. Size)

A=________
B=________
C=________
D=________
E=________

BISG-3 = ________

$$\text{Average BISG} = \frac{(\text{BISG-1}) + (\text{BISG-2}) + (\text{BISG-3})}{3}$$

$$\text{Average BISG} = \frac{(\qquad) + (\qquad) + (\qquad)}{3}$$

Average BISG = ____________________

Item P-602S
Emulsified Asphalt Prime Coat
SUPPLEMENT

The work to be performed under the classification of Emulsified Asphalt Prime Coat shall meet the requirements of Section P-602 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

REPLACE the title of Section P-602 to

SECTION P-602 EMULSIFIED ASPHALT PRIME COAT

DESCRIPTION

MATERIALS

DELETE article 602-2.1 in its entirety an**d INSERT:**

602-2.1 Emulsified Asphalt material. The emulsified asphalt material shall be as specified in ASTM D3628 for use as a prime coat appropriate to local conditions. The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the emulsified asphalt material. The COA shall be provided to and approved by the Resident Project Representative (RPR) before the emulsified asphalt material is applied. The furnishing of the COA for the emulsified asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

CONSTRUCTION METHODS

ADD to article 602-3.2 the following paragraph:

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the RPR.

DELETE article 602-3.3 in its entirety and **INSERT:**

602-3.3 Application of emulsified asphalt material. Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The asphalt emulsion material shall be uniformly applied with an asphalt distributor at the rate of 0.15 to 0.30 gallons per square yard (0.68 to 1.36 liters per square meter) depending on the base course surface texture. The type of asphalt material and application rate shall be approved by the RPR prior to application.

Following application of the emulsified asphalt material and prior to application of the succeeding layer of pavement, allow the asphalt coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread sand to effectively blot up and cure excess asphalt material. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner. Keep traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

ADD article 602-3.4a **TRIAL APPLICATION RATES**

602-3.4a Trial application rates. The Contractor shall apply a minimum of three lengths of at least 100 feet (30 m) for the full width of the distributor bar to evaluate the amount of emulsified asphalt material that can be satisfactorily applied with the equipment. Apply three different application rates of emulsified asphalt materials within the application range specified in paragraph 602-3.3. Other trial applications can be made using various amounts of material as directed by the RPR. The trial application is to demonstrate the equipment can uniformly apply the emulsified asphalt material within the rates specified and determine the application rate for the project.

METHOD OF MEASUREMENT

DELETE Article 602-4 in its entirety and **INSERT** the following**:**

602-4.1 The emulsified asphalt material for prime coat shall be measured by the gallon. Volume shall be corrected to the volume at 60°F (16°C) in accordance with ASTM D4311. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of emulsified asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

BASIS OF PAYMENT

DELETE Article 602-5 in its entirety and **INSERT** the following:

602-5.1 Payment shall be made at the contract unit price per gallon for emulsified asphalt prime coat. This price shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item P-602-5.1 Emulsified Asphalt Prime Coat - per gallon

INSERT the references (publications) below into MATERIALS AND TESTING REQUIREMENTS Section

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END OF ITEM P-602

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SECTION P-602 BITUMINOUS PRIME COAT

DESCRIPTION

602-1 Work under this section consists of an application of bituminous material, including a cover cost, on the prepared base course in accordance with these Specifications and in reasonably close conformity to the lines shown on the plans.

MATERIALS

602-2.1 BITUMINOUS MATERIAL. Prime coat shall be Rapid Curing Cut-Back Asphalt Grade RC-70 conforming to the requirements of ASTM D-2028. The material shall be applied at a temperature range of not less than 120° F *(50° C)*. The maximum temperature for the cutback asphalt shall be that at which fogging occurs.

602.2.2 COVER AGGREGATE. Cover aggregates shall consist of Miami Oolitic Limerock screenings conforming to the following gradation, when tested in accordance with ASTM C-136, and shall be coated (using heated aggregates) with hot Asphalt-Cement viscosity grade AC-20; the cover aggregate shall contain approximately 4 percent of bituminous material, determined by extraction in accordance with ASTM D-2172, Test Method A.

SIEVE SIZE	PERCENT PASSING
No. 4 *(4.75 mm)*	100
10 *(2 mm)*	95-100
40 *(0.425 m)*	55-75
80 *(0.18 mm)*	20-30
200 *(0.075 mm)*	0-8

CONSTRUCTION METHODS

602-3.1 WEATHER LIMITATIONS. The prime coat shall be applied only when the existing surface is dry or contains sufficient moisture to promote uniform distribution of the bituminous material, when the atmospheric temperature is above 60° F *(16° C)*, and when the weather is not foggy or rainy. The temperature requirements may be waived, but only when so directed by the Architect/Engineer.

602-3.2 EQUIPMENT AND TOOLS. The Contractor shall provide the following items of equipment for the construction of the Bituminous Prime Coat:

a. Self-Powered Pressure Bituminous Material Distributor. The distributor shall have pneumatic tires of such width and number that the load produced on the pavement surface shall not exceed 650 pounds per inch *(118 Kgs per cm)* of the tire width and it shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent. Distributor equipment shall include a tachometer, pressure gages, volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

b. Aggregate Spreader. The aggregate spreader shall be a self-propelled mechanical spreader or truck-attached mechanical spreader capable of uniformly distributing aggregate at the specified rates, producing an even spread at least 12 inch *(30 cm)* in width.

c. Pneumatic-tired Rollers. The pneumatic-tired rollers shall have an effective rolling width of at least 60 inches *(150 cm)* and capable of exerting a minimum contact pressure of 40 pounds per square inch *(276 K Pa)*.

d. Steel Wheel Rollers. All steel wheel rollers shall be self-propelled 3 to 5 ton *(2700 - 4500 Kgs)* tandem type rollers. The wheels on the rollers shall be equipped with adjustable scrapers which shall be used when necessary to clean the wheel surfaces. Rollers shall be equipped with tanks and sprinkling apparatus which shall be used to keep the wheels wet and prevent the surfacing materials from sticking.

e. Power Broom. A power broom and a drag broom shall be provided for evenly spreading the cover aggregate material and later removing loose material from the surface to be prime coated.

f. Equipment for handling aggregates and such auxiliary equipment as needed to perform the work.

g. All equipment shall be subject to approval by the Architect/Engineer.

602-3.3 APPLICATION OF BITUMINOUS MATERIAL AND COVER AGGREGATE. Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

When the surface of the swept base is visibly dry, it shall be lightly sprinkled with water immediately before applying the prime coat. This will prevent "frog-eying" of the bituminous prime material during application over the cleaned base surfaces.

The application of the bituminous material shall be made by means of a pressure distributor at the temperature, pressure, and in the amounts approved by the Architect/Engineer.

Immediately after application of liquid bituminous material, a blotter coat of the bitumen coated limerock screenings shall be spread uniformly over the primed surfaces. Spreading shall be evenly accomplished using the mechanical spreader. Depth of spread shall be sufficient to prevent pickup of bituminous material by the mechanical spreader truck. The area covered with the cover aggregates shall be lightly dragged with a drag broom.

The approximate rate of application for the prime coat materials shall be as follows:

Bituminous Material -	0.10 to 0.20 gallon per square yard *(0.45 to 0.90 liters per sq. meters)*
Cover Aggregate -	5 to 8 pounds per square yard *(2.7 to 4.3 kgs per sq. meters)*

The exact amounts to be used shall be as approved by the Architect/Engineer, in writing.

Power rollers shall be used immediately after the aggregate is spread. A single pass with no overlap, using a 3 to 5 ton *(2700-4500 kgs)* tandem steel-wheel power roller, shall be made. Following the rolling with the steel-wheel roller, the course shall be further rolled with a pneumatic roller to insure proper embedding of cover aggregate into the bitumen. The rolling shall be continued until no more aggregate material can be worked into the surface.

After curing, the primed and covered area shall be swept with a power broom to remove excess limerock screenings.

The primed surface shall be maintained by the Contractor until the bituminous surface treatment (P-609) has been placed. Suitable precautions shall be taken by the Contractor to protect the primed surface against damage during this interval, including supplying and spreading any cover aggregate necessary to blot up excess bituminous material.

602-3.4 BITUMINOUS MATERIAL CONTRACTOR'S RESPONSIBILITY. Samples of the bituminous materials that the Contractor proposes to use, together with a statement as to their source and character, must be submitted and approved before use of such material begins. The Contractor shall require the manufacturer or producer of the bituminous materials to furnish material subject to this and all other pertinent requirements of the contract. Only satisfactory materials, so demonstrated by service tests, shall be acceptable.

The Contractor shall furnish vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The report shall be delivered to the Architect/Engineer before permission is granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as basis for final acceptance. All such test reports shall be subject to verification by testing samples of materials received for use on the project.

FDOT test reports confirming compliance with the requirements of these Specifications may be accepted in lieu of the vendor's certified test reports.

602-3.5 FREIGHT AND WEIGH BILLS. Before the final Contractor's requisition for payment is processed, the Contractor shall file with the Architect/Engineer receipted bills when railroad shipments are made, and certified weigh bills when materials are received in any other manner, of the bituminous materials actually used in the construction covered by the contract. The Contractor shall not remove bituminous material from the tank car or storage tank until the initial outage and temperature measurements have been taken by the Architect/Engineer, nor shall the car or tank be released until the final outage has been taken by the Architect/Engineer.

Copies of freight bills and weigh bills shall be furnished to the Architect/ Engineer during the progress of the work.

METHOD OF MEASUREMENT

602-4 The bituminous material for prime coat shall be measured by the gallon. Volume shall be corrected to the volume at 60° F *(16° C)* in accordance with ASTM D 1250 and API Std 2540.

No separate measurement for payment will be made for the cover aggregates or the bituminous material included in the cover aggregates (bitumen impregnated limerock screening). The costs of furnishing and applying such material shall be considered incidental to and included in the Contract Unit Price Bid for Bituminous Prime Coat.

BASIS OF PAYMENT

602-5 Payment shall be made at the contract unit price per gallon for bituminous prime coat. This price shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete the work under this Section.

Payment will be made under:

Item	Bituminous Prime Coat--per gallon

MATERIAL REQUIREMENTS

ASTM D 2028	Asphalt, Cutback (Rapid Curing Grade)

TESTING REQUIREMENTS

ASTM C-136	Sieve Analysis
ASTM D 2172	Extraction of Bituminous
ASTM D 1250	Petroleum Measurement Tables
API Std 2540	Volume Correction for Asphalts

END OF SECTION

Item P-603S
Emulsified Asphalt Tack Coat

SUPPLEMENT

The work to be performed under the classification of BITUMINOUS TACK COAT shall meet the requirements of Section P-603 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

REPLACE the title of this Section to: **Emulsified Asphalt Tack Coat**

DELETE the entire specification and **INSERT** the following:

DESCRIPTION

603-1.1 This item shall consist of preparing and treating an asphalt or concrete surface with asphalt material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

MATERIALS

603-2.1 Asphalt materials. The asphalt material shall be an emulsified asphalt conforming to one of the following: SS-1, SS-1h, MS-1, or HFMS-1 in accordance with ASTM D977, or CSS-1 or CSS-1h in accordance with ASTM D2397. The emulsified asphalt shall not be diluted. Asphalt meeting PG 64-22 in accordance with ASTM D6373, e.g. neat binder, can be used for night construction or when accelerated set of the tack coat is required. The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the asphalt material to the Resident Project Representative (RPR) before the asphalt material is applied for review and acceptance. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

CONSTRUCTION METHODS

603-3.1 Weather limitations. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F or above; the temperature has not been below 35°F for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the RPR.

603-3.2 Equipment. The Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or seven hundred (700) feet per minute.

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the tack operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the RPR.

A power broom and/or power blower suitable for cleaning the surfaces to which the asphalt tack coat is to be applied shall be provided.

603-3.3 Application of emulsified asphalt material. The emulsified asphalt shall not be diluted. Immediately before applying the emulsified asphalt tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material.

The emulsified asphalt material shall be uniformly applied with an asphalt distributor at the rates appropriate for the conditions and surface specified in the table below. The type of asphalt material and application rate shall be approved by the RPR prior to application and shall be noted in the Contractor's daily QC report.

Emulsified Asphalt

Surface Type	Residual Rate, gal/SY	Emulsion Application Bar Rate, gal/SY
New asphalt	0.04-0.05	0.06-0.07
Existing asphalt	0.04-0.07	0.06-0.11
Milled Surface	0.04-0.08	0.06-0.12

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the RPR. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the Contractor's expense.

603-3.3.1 Control Strip. Prior to full production, the contractor shall demonstrate the application methods and bonding between layers with a control strip. The control strip shall represent 250 tons of asphalt. A separate control strip shall be performed where asphalt is placed on an existing milled surface and where asphalt is placed on an underlying lift of asphalt placed during this project. The Contractor shall obtain five 6-inch diameter cores from the locations randomly determined, and marked in the field, by the RPR. Bonding of the layers shall be determined in accordance with Florida Test Method FM 5-599. The average bond strength of the five cores shall be a minimum of 100 psi. If the average bond strength is below 100 psi, the Contractor shall adjust their means/methods and/or the application rate and place another control strip. Unacceptable control strips shall be removed and replaced at the Contractor's expense. Full production shall not commence until the control strips are accepted in writing by the RPR.

Provide the laboratory's certificate of accreditation for Florida Test Method FM 5-599 with the CQCP.

603-3.4 Freight and waybills The Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the RPR certified waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the pavement covered by the contract. Do not remove emulsified asphalt material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

METHOD OF MEASUREMENT

603-4.1 The emulsified asphalt material for tack coat shall be measured by the gallon. Volume shall be corrected to the volume at 60°F in accordance with ASTM D1250. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of emulsified asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

BASIS OF PAYMENT

603.5-1 Payment shall be made at the contract unit price per gallon of emulsified asphalt material. This price shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, testing, and incidentals necessary to complete the item. If neat binder is used in lieu of emulsified asphalt, it shall be paid in accordance with Pay Item P-603-5.1.

Payment will be made under:

Item P-603-5.1	Emulsified Asphalt Tack Coat - per gallon

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D1250	Standard Guide for Use of the Petroleum Measurement Tables
ASTM D2397	Standard Specification for Cationic Emulsified Asphalt
ASTM D2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
ASTM D6373	Standard Specification for Performance-Graded Asphalt Binder

END ITEM P-603

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SECTION P-603
BITUMINUOUS TACK COAT

603-1 The work under this Section consists of preparing and treating a bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

MATERIALS

603-2 BITUMINOUS MATERIALS. The bituminous material shall be Emulsified Asphalt, Grade SS-1h conforming to the requirements of ASTM D 977 or Cationic Emulsified Asphalt Grade CSS-1h conforming to the requirements of ASTM D2397, as directed by the Architect/Engineer. The material shall be applied at a temperature range of not less than 75° F *(25° C)* and not more than 130° F *(55° C)*.

CONSTRUCTION METHODS

603-3.1 WEATHER LIMITATIONS. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is above 60° F *(16° C)* and when the weather is not foggy or rainy. The temperature requirements may be waived, but only when so directed by the Architect/Engineer.

603-3.2 EQUIPMENT. The Contractor shall provide equipment for heating and applying the bituminous tack coat.

The distributor shall have pneumatic tires of such width and number that the load produced on the pavement surface shall not exceed 650 pounds per inch *(118 Kgs per cm)* of the tire width and it shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent. Distributor equipment shall include a tachometer, pressure gages, volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

A power broom and/or blower and a drag broom shall be provided for any required cleaning of the surface to be treated.

All equipment shall be subject to approval by the Architect/Engineer.

603-3.3 APPLICATION OF BITUMINOUS MATERIAL. Immediately before applying the tack coat, the full width of surface to be treated shall be swept with a power broom and airblast to remove all loose dirt and other objectionable material.

Emulsified asphalt shall be diluted by the addition of water when directed by the Architect/Engineer, in writing, and shall be applied a sufficient time in advance of the paver to ensure that all water has evaporated before any of the overlying mixture is placed on the tacked surface.

The bituminous material including vehicle shall be uniformly applied with a bituminous distributor at the rate of 0.02 to 0.15 gallons per square yard *(0.09 to 0.67 liter per sq. meter)* depending on the condition of the existing surface. The type of bituminous material and application rate shall be approved by the Architect/Engineer, in writing, prior to application.

Following the application, the surface shall be allowed to cure without being disturbed for such period of time as may be necessary to permit drying out and setting of the tack coat. This period shall be determined by the Architect/Engineer. The surface shall then be maintained by the Contractor until the next course has been placed. Suitable precautions shall be taken by the Contractor to protect the surface against damage during this interval.

Protective measures shall be taken by the Contractor to prevent the tracking or careless spraying of bituminous materials onto abutting concrete aprons, curbs, structures, asphalt surfaced areas not scheduled for surfacing, etc. Any inadvertent overspray or tracking of bituminous material onto concrete apron areas shall be promptly cleaned by the Contractor with solvents or by other acceptable methods. No additional payment shall be made to the Contractor for such work.

603-3.4 BITUMINOUS MATERIAL-CONTRACTOR'S RESPONSIBILITY. Samples of the bituminous material that the Contractor proposes to use, together with a statement as to its source and character, must be submitted and approved before use of such material begins. The Contractor shall require the manufacturer or producer of the bituminous material to furnish material subject to this and all other pertinent requirements of the contract. Only satisfactory materials so demonstrated by service tests, shall be acceptable.

The Contractor shall furnish the vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The report shall be delivered to the Architect/Engineer before permission is granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports shall be subject to verification by testing samples of material received for use on the project.

FDOT test reports confirming compliance with the requirements of these Specifications may be accepted in lieu of the vendor's certified test reports.

603-3.5 FREIGHT AND WEIGH BILLS. Before the final Contractor's requisition for payment is processed the Contractor shall file with the Architect/Engineer receipted bills when railroad shipments are made, and certified weigh bills when materials are received in any other manner, of the bituminous materials actually used in the construction covered by the contract. The Contractor shall not remove bituminous material from the tank car or storage tank until the initial outage and temperature measurements have been taken by the Architect/Engineer, nor shall the car or tank be released until the final outage has been taken by the Architect/Engineer. Copies of freight bills and weigh bills shall be furnished to the Architect/Engineer during the progress of the work.

METHOD OF MEASUREMENT

603-4 The bituminous material for tack coat shall be measured by the (gallon) *(liter)*. Volume shall be corrected to the volume at 60° F *(16° C)* in accordance with Table IV-3 of The Asphalt Institute's Manual MS-6 for emulsified asphalt. Dilution water added to emulsified asphalt will not be measured for payment.

BASIS OF PAYMENT

603.5 Payment shall be made at the contract unit price per (gallon) *(liter)* of emulsified asphalt. This price shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item	Bituminous Tack Coat--per (gallon) *(liter)*

MATERIAL REQUIREMENTS

ASTM D 977	Emulsified Asphalt
ASTM D 2397	Cationic Emulsified Asphalt
Asphalt Institute Manual MS-6 Table IV-3	Temperature-Volume Corrections for Emulsified Asphalts

END OF SECTION

Item P-605S
Joint Sealants for Pavements
SUPPLEMENT

The work to be performed under the classification of JOINT SEALING FILLER shall meet the requirements of Section P-605 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

REPLACE the title of this Section to: **Joint Sealants for Pavements**

DELETE the entire specification and **INSERT the following:**

DESCRIPTION

605-1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints between different types of pavements.

MATERIALS

605-2.1 Joint sealants. Joint sealant materials shall meet the requirements of ASTM D5893 self-leveling. Provide manufacturer's installation instructions with material submittal a minimum of 14 days prior to commencing the work.

Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the sealant meets the requirements of this specification.

605-2.2 Backer rod. The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be 25% ± 5 % larger in diameter than the nominal width of the joint.

605-2.3 Bond breaking tapes. Not used.

CONSTRUCTION METHODS

605-3.1 Time of application. Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be 50°F and rising at the time of application of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

605-3.2 Equipment. Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

a. Tractor-mounted routing tool. Not used.

b. Concrete saw. Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified.

c. Sandblasting equipment. Sandblasting is not allowed.

d. Waterblasting equipment. The Contractor must demonstrate waterblasting equipment including the pumps, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 605-3.3. The Contractor shall demonstrate, in the presence of the RPR, that the method cleans the joint and does not damage the joint.

e. Hand tools. Hand tools may be used, when approved, for cleaning the joint faces. Hand tools should be carefully evaluated for potential spalling effects prior to approval for use.

f. Hot-poured sealing equipment. Not used.

g. Cold-applied, single-component sealing equipment. The equipment for installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

605-3.3 Preparation of joints. Pavement joints for application of material in this specification must be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. The Contractor shall demonstrate, in the presence of the RPR, that the method cleans the joint and does not damage the joint.

a. Sawing. All joints shall be sawed in accordance with specifications and plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

b. Sealing. Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign material from the sides and upper edges of the joint space to be sealed. Cleaning shall be accomplished by waterblaster as specified in paragraph 605-3.2. The newly exposed concrete joint faces and the pavement surface extending a minimum of 1/2 inch from the joint edge shall be waterblasted clean. Waterblasting shall be accomplished in a minimum of two passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and not more than 3 inches from it. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water. The joint faces shall be surface dry when the seal is applied.

c. Backer Rod. When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a backer rod in accordance with paragraph 605-2.2 to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backer rod is placed at the specified depth and is not stretched or twisted during installation.

d. Bond-breaking tape. Not used.

605-3.4 Installation of sealants. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the RPR before sealing is allowed. Sealants shall be installed in accordance with the manufacturer's installation instructions and the following requirements:

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to the depth shown on the plans. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the RPR. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

605-3.5 Inspection. The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified at no additional cost to the airport.

605-3.6 Clean-up. Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

METHOD OF MEASUREMENT

605-4.1 Joint sealing material shall be measured by the linear foot of sealant in place, completed, and accepted.

BASIS OF PAYMENT

605-5.1 Payment for Joint Sealing Filler, Self-Leveling shall be made at the contract unit price per linear foot. The price shall be full compensation for furnishing all materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-605-5.1	Joint Sealing Filler, Self-Leveling - per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D789	Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)
ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids

END ITEM P-605

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SECTION P-605
JOINT SEALING FILLER

DESCRIPTION

605-1 The work under this Section consists of providing and installing a cold applied resilient and adhesive joint sealing filler capable of effectively sealing joints in Portland cement concrete pavement, between Portland cement concrete pavements and structures, between Portland cement and asphaltic concrete pavements, and for sealing cracks in Portland cement concrete pavements. The cold applied joint sealant shall consist of a single component silicone base sealant or two-component elastomeric sealant.

Unless otherwise specified or shown on the Plans, cold applied single component silicone sealant shall be used.

Hot applied joint sealant may also be used, only when its use is specified on the Plans or the Contract Supplemental Specifications.

The joint sealant shall be resistant to jet fuels and hydraulic fluids. The joint sealant shall have not less than five years successful experience in sealing Airport concrete pavement joints.

MATERIALS

605-2.1 COLD-APPLIED SINGLE COMPONENT SEALANT. The joint sealing material shall meet the requirements shown in Table 1.

TABLE 1 - SILICONE SEALANT REQUIREMENT

A. GUN GRADE

(For Sealing PCC to PCC Pavement
and PCC Pavement to Structures)

Test Method	Test	Material Requirement
As Supplied		
	Appearance	Smooth, uniform gray paste
MIL-S-8802	Flow, Maximum	0.3
MIL-S-8802	Tack-Free Time, minutes	75 maximum
Upon Complete Cure		
ASTM D-2240	Durometer[1], Shore A	12 to 25
ASTM D-412, Die C	Modulus, at 150% elongation[1], maximum	45 *psi* *(310kPa)*
ASTM D-412, Die C	Elongation[1], % minimum	1000
ASTM D-3583	Adhesion to Concrete[1] minimum % elongation	500
MIL-S-8802	Peel Adhesion to Unprimed Concrete, lbs/inch minimum *(Kgs/cm minimum)*	20 *(3.6)*
Performance		
ASTM C-719	Movement, 10 cycles at $\pm 50\%$[2]	No failure

B. SELF-LEVELING GRADE

(For Sealing PCC to Asphaltic Concrete Pavement and Pavement to Structures)

Test Method	Test	Material Requirement
As Supplied		
MIL-S-8802	Flow, sag or slump	Self-Leveling
MIL-S-8802	Skin-Over Time, at 25°C (77°F), minutes	25
Upon Complete Cure		
ASTM D-3583	Modulus, at 150% elongation[3], maximum	25 *psi* *(172 kPa)*
ASTM D-412, Die C	Elongation[1], % minimum	1200
ASTM D-3583	Adhesion to Concrete[3] minimum % elongation	500
ASTM D-3583	Adhesion to Asphalt Concrete[3] minimum % elongation	500
MIL S-8802	Peel Adhesion to Unprimed Concrete, lbs/inch, minimum *(Kgs/cm, minimum)*	20 *(3.6)*
Performance		
ASTM C-719	Movement, 10 cycles at ±50%[2]	No failure

[1]Sample cured 7 days at 77 ± 2° F *(25 ± 1° C)* and 50 ± 5% relative humidity. Proper joint design and proper joint preparation are necessary for maximum performance.

[2]Randomly tested by the manufacturer; test not less than one sample per lot of manufactured sealant furnished on the project.

[3]Sample cured 21 days at 77 ± 2° F *(25 ± 1° C)* and 40 ± 5% relative humidity. Proper joint design and proper joint preparation are necessary for maximum performance.

605-2.2 COLD-APPLIED TWO COMPONENT SEALANT. Cold-applied two-component joint sealing compounds for sealing joints in Portland cement concrete pavement and between Portland cement concrete pavement and structures shall meet the requirements of Federal Specification SS-S-200, two-component, elastomeric, polymer type, jet-fuel-resistant for concrete pavements.

605-2.3 HOT-APPLIED JOINT SEALANT. Hot-poured joint sealing materials shall be similar or equal to Superior Products Superseal 777, and meeting the requirements of ASTM D-3569 and D-3583 or ASTM D-3581 and D-3582.

Joint materials to be applied to seal PCC to Asphaltic concrete pavements shall be tested for compatibility with asphalt in accordance with ASTM D-3407 prior to its use. Materials found to be not compatible with the asphalt pavements shall not be used for such application.

605-2.4 SEALING CRACKS IN PORTLAND CEMENT CONCRETE PAVEMENT. Cold applied self-leveling sealant meeting the requirements in Table 1.B. shall be used in sealing cracks in Portland cement concrete pavement.

605-2.5 PREFORMED BACKER RODS. Preformed backer rods, as shown on the plans, shall be used with cold applied sealants. Backer rods shall be manufactured from closed cell polyethylene (resilient) foam rubber compatible with the sealant, and recommended for such use by the sealant manufacturer. Backer rods shall not adhere to the pavement or to the sealant, shall be compressible without extruding the sealant, and shall recover to maintain contact with the joint faces when the joint is open, as approved by the Architect/ Engineer. Backer rods shall have a diameter approximately 25% larger than the joint width (unless otherwise shown on the Plans or approved by the Architect/ Engineer). Backer rods shall always be compressed in its installed position between the joint surfaces.

605-2.6 CONTRACTOR'S SUBMITTALS. Samples of all materials which the Contractor proposes for use and copies of the manufacturer's recommendations for mixing and installation shall be submitted to the Architect/Engineer for approval at least thirty (30) days prior to use.

Each lot or batch of sealing material shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be labeled to include the following:

Name of Material ....Manufacturer's Name
Manufacturer's Lot Number
Safe Heating Temperature (for hot applied sealants)
Production Date
Shelf Life
Pot Life (for two components sealants)
Mixing Instructions
Storage Instructions
Placement Instructions

Each lot or batch delivered to the job shall also be accompanied by a "Material Safety Data Sheet" (MSDS), and the Manufacturer's Certification stating that the compound meets the requirements of this specification including its compliance with the jet fuel and hydraulic fluids resistance provisions.

When required by the Architect/Engineer, the Contractor shall provide test reports of the sealant properties demonstrating conformance of the sealant to the Contract Specifications.

When required by the Contract Supplementary Specifications, the Contractor shall have a manufacturer's technical representative on the project at the start of the joint sealing operation to observe the methods and means employed by the Contractor to install the joint sealer. When required by the Contract Supplementary Specifications, the manufacturer of the sealant shall provide a 5-year guarantee on the performance of the joint sealer.

CONSTRUCTION METHODS

605-3.1 TIME OF APPLICATION. The joints shall be sealed immediately following the concrete curing period or as soon thereafter as weather conditions permit, and before the pavement is used for material storage or opened to traffic, including construction equipment traffic. At the time of application of the sealing compound, the atmospheric and pavement temperature shall be above 50^{o} F *(10° C)* and the weather shall not be rainy or foggy. The temperature requirements may be waived only when so directed in writing by the Architect/Engineer.

The concrete shall be cured and dry (not less than 7 days old unless otherwise ordered by the Architect/Engineer), and the joint surfaces shall be clean at the time of the sealant application.

605-3.2 EQUIPMENT. All equipment necessary for the proper construction of this work shall be on the project in first class working condition. The equipment shall be as recommended by the manufacturer of the sealer and approved by the Architect/Engineer before construction is started.

Air compressors shall be equipped with suitable traps capable of removing all free water and oil from the compressed air and shall be capable of furnishing air with a pressure greater than 90 psi *(620 k Pa)*.

The equipment for cleaning joint openings shall consist of powered brooms, air blasters, sand blasters, water blasters, and, if necessary, joint cleaning and grooving machines and any other equipment necessary to produce a satisfactory clean and dry joint. Similar equipment shall be provided for cleaning joints previously sealed.

605-4 PREPARATION OF JOINTS.

605-4.1 SEALING NEW JOINTS. Immediately before sealing, the temporary backer rods (installed at the time of saw cutting the joints, as specified under Section P-501) shall be removed, the joints shall be thoroughly cleaned of all laitance, curing compound, protrusions or hardened concrete, dirt, dust, vegetation and other foreign material.

All joints shall be cleaned of contaminants and impurities to the depth at which the sealant and permanent backer rod are to be installed. Cleaning may require saw cutting immediately followed by water washing to remove residual laitance. After drying, at least the top inch of each joint face shall be sandblasted to ensure a sound, clean surface for sealant application.

Sandblasting shall be performed in two passes (one for each joint face) with the nozzle held at an angle to the face and no more than 2 inches *(50 mm)* from it.

Any irregularity in the joint face resulting from tearing, spalls, saw misalignment, etc., which would prevent contact between the sealant and the clean and sound joint face, shall be corrected prior to installation of the sealer.

After sandblasting, dust, loose particles and other debris shall be blown from the joints, in one direction only, using oil-free compressed air. Surfaces shall be clean, dry, and dust-free as demonstrated by running a finger along the joint face. If a white, chalky dust appears on the finger, the joint must be recleaned. When sealing a joint between Portland cement concrete and asphaltic concrete pavements, the sawing and cleaning operations shall be performed such that no residual asphalt remains on the concrete face and the asphaltic face is sound.

The joint faces shall be clean sound and surface dry when the permanent backer rod and the joint sealant are installed.

Sandblasting in the vicinity of aircraft, buildings or ground equipment shall be controlled to prevent damage to aircraft, buildings and ground equipment.

The surface preparation and application of the joint sealer shall be in strict accordance with the sealer's manufacturer written instructions, and these specifications.

Joint surfaces shall be primed, as and where recommended by the sealant manufacturer, and as approved by the Architect/Engineer.

605-4.2 RESEALING EXISTING JOINTS. Prior to resealing existing joints, the existing joint material (including backing materials), shall be removed to the depth shown on the Plans or as directed. The Contractor shall, if necessary, widen the joint to create clean and sound joint surfaces. All removed material shall become the Contractor's property and shall be removed and legally disposed of, by the Contractor, away from the airport.

Cleaning of existing joints to be resealed shall be accomplished as specified above and in Section P-501 for new joints, and new backer rods shall be installed prior to the application of the joint sealer.

605-4.3 SEALING CRACKS. When it is necessary to seal random cracks, they shall be sawcut or routed, to create a clean, sound and even surface and they shall be cleaned in a manner satisfactory for sealing by methods and equipment similar to that used for the constructed joints, as specified above and in Section P-501.

605-5 INSTALLATION OF SEALANTS.

605-5.1 General. Joints shall be inspected for proper width, depth, alignment, condition of the concrete or asphalt, joint surfaces, joint preparation, and shall be approved by the Architect/Engineer before sealing is performed. Sealant shall be installed in accordance with the manufacturer's written recommendations and the following requirements:

605-5.2 BACKING MATERIALS. Backer rods shall be installed, using a suitable roller device recommended for such use by the sealant manufacturer, at the bottom of the joint to be filled to control the depth of the sealant, to achieve the desired shape factor, to prevent the sealant from bonding to the bottom edge of the joint, and to support the sealant against indentation and sag.

605-5.3 COLD-APPLIED SEALANTS. Cold-applied sealant shall be applied in a continuous operation, pumped directly from the original containers using an approved mechanical device that will force the sealing material to the bottom of the joint and completely fill the joint to the proper depth and width shown on the Plans, without flowing or spilling the material onto the surface of the pavement. The sealant shall adhere to the concrete and/or asphaltic concrete and shall be free of voids. Gun grade sealant shall be tooled, forcing it onto the backer rod and against the joint faces with an appropriate tool, to produce a slightly concave surface approximately 1/4 inch *(6 mm)* below the pavement surface. Tooling shall be accomplished before a skin forms on the surface, usually within 10 minutes of application. The self leveling cold applied sealant shall be recessed 1/4 inch *(6 mm)* below pavement surface. Sealant which does not bond to the concrete surface of the joint walls, contains voids, or fails to set to a tack-free condition, or does not provide the specified recess will be rejected and replaced by the Contractor at no additional cost to the County. During the course of the work any batches of sealant that do not have the proper consistency for application shall be replaced. Any sealant deposited on the pavement surface shall be immediately removed.

605-5.4 HOT POURED SEALANTS. The hot poured joint sealant shall be applied uniformly solid from bottom to top of the joint and the joint shall be filled without formation of entrapped air or voids. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to more than 20° F *(11° C)* below the safe heating temperature. The safe heating temperature shall be obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint shall be provided. Any sealant spilled on the surface of the pavement shall be removed immediately. The sealant shall be recessed 1/4 *inch (6 mm)* below pavement surface.

605-6 FIELD TEST. Before sealing the joints, the Contractor shall demonstrate that the equipment and procedures for preparing the joint and mixing and placing the sealant will produce a satisfactory joint seal. The demonstration shall include the preparation of two small batches and the application of the resulting material.

The Project Testing Laboratory, may (if ordered by the Architect/Engineer) take cores of joints to test the quality of joint sealants and its adhesion to the PCC and/or asphaltic concrete surfaces, for acceptance purposes. The Contractor shall immediately reseal the joints at each cored location. Core diameters shall be approximately 2 times the width of the joint.

605-7 MANUFACTURER'S REPRESENTATIVE. When required by the Contract Technical Specifications, a manufacturer's representative(s) shall conduct the demonstration(s), train the Contractor's personnel, and ensure that the installation procedures are in accordance with the manufacturer's directions prior to the start of the sealing operations. The representative(s) shall visit the job site at least two (2) times during the sealing operation, during surface preparation, and after the sealing is completed. He shall conduct a general inspection of the work and perform more extensive inspections and/or testing on a random basis to assure that the construction is in accordance with the manufacturer's recommended construction methods and procedures. The manufacturer's representative shall prepare and submit a report outlining his findings to the Architect/Engineer at the completion of his inspections.

METHOD OF MEASUREMENT

605-8.1 The joint sealing filler installed in conjunction with new pavement construction shall not be measured as a separate quantity item, rather it shall be included as an incidental work under the pavement items in the Contract.

605-8.2 Measurement of Cleaning and Resealing Joints in Existing Concrete Pavement and of Cleaning and Sealing Cracks in Existing Concrete Pavement shall be the length in linear (feet) *(meters)* of joints or cracks actually cleaned, sealed, completed and accepted in accordance with the Plans and these Specifications.

BASIS OF PAYMENT

605-9.1 No separate payment will be made for Joint Sealing Filler installed as specified under this Section in conjunction with new pavement construction. Cost of furnishing and installing Joint Sealing Filler installed in conjunction with new pavement construction shall be considered as a subsidiary obligation in the completion of the construction of concrete pavement, structures and asphaltic concrete pavement.

605-9.2 Payment for the quantities measured as described in Article 605-8.2 above, shall be made at the Contract unit prices bid, per linear (foot) *(meter)* for items Cleaning and Resealing Joints in Existing Concrete Pavement and for Cleaning and Sealing Cracks in Existing Concrete Pavement which prices and payment shall be full compensation for furnishing all labor, materials, equipment, processes, tools and incidentals necessary to complete the work covered under this Section.

Payment will be made under:

Item No.___	Cleaning and Resealing Joints in Existing Concrete Pavement	Per Linear (Foot) *(Meter)*
Item No.___	Cleaning and Sealing Cracks in Existing Concrete Pavement	Per Linear (Foot) *(Meter)*

TESTING AND MATERIAL REQUIREMENTS

Test and Short Title	
MIL-S-8802	Flow, Extrusion Rate, Tack-Free Time, Adhesion
ASTM D-412, Die C	Modulus, Elongation
ASTM C-719	Movement
ASTM D-2240	Durometer Hardness
ASTM D-3407	Compatibility with Asphalt
ASTM D-3582	Testing Joint Sealant
ASTM D 3583	Testing Joint Sealant

Material and Short Title

Fed. Specs SS-S-200	Sealer
ASTM D-3569	Sealer
ASTM D-3581	Sealer

END OF SECTION

SECTION P-609S
BITUMINOUS SINGLE SURFACE TREATMENT (SST)
SUPPLEMENT

The work to be performed under the classification of **Bituminous Single Surface Treatment (SST)** shall meet the requirements of Section P-609 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

BASIS OF PAYMENT

DELETE article 609-5 pay items and INSERT the following:

Payment will be made under:

P-609-5.1	Bituminous Single Surface Treatment Material – SST -- per Gallon
P-609-5.2	Aggregate Single Surface Treatment - SST -- per Ton

END OF SECTION

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SECTION P-609
BITUMINUOUS SINGLE SURFACE TREATMENT (SST)

DESCRIPTION

609-1.1 The work under this Section consists of a bituminous surface treatment as a wearing course composed of a single application of bituminous material and aggregate cover placed on the prepared primed base or properly cured wearing surface, in accordance with these specifications, and shall conform to the dimensions and typical cross section and within the lines and grades shown on the Plans.

609-1.2 QUANTITIES OF MATERIALS PER SQUARE YARD. The approximate amounts of materials per square yard (square meter) for the bituminous surface treatment shall be as follows:

Bituminous Material (Emulsified Asphalt)	0.18 to 0.35 gallons per square yard *(0.81 to 1.58 liters per sq. meter)*
Cover Aggregate Material	10 to 13 pounds per square yard *(5.4 to 7.0 kgs per sq. meter)*

The exact amounts to be used shall be determined in the field by the Architect/Engineer.

MATERIALS

609-2.1 AGGREGATE MATERIALS. Cover aggregate material shall be manufactured, crushed, washed, and screened limerock, and shall be manufactured from sound, hard, durable rock of accepted quality and crushed to specification size. All strata, streaks, and pockets of clay, marl, dirt, sandstone, soft rock, organic, or other unsuitable material accompanying the sound rock shall be discarded and not allowed to enter the crusher.

The crushed cover aggregate shall not contain more than 8%, by weight, of elongated or flat pieces and shall be free from wood, roots, vegetable, organic, or other extraneous matter. A flat or elongated particle is one having a ratio between the maximum and the minimum dimensions of a circumscribing rectangular prism exceeding 5 to 1. The cover aggregate shall have a percentage of wear not more than 40 at 500 revolutions, as determined by ASTM C 131.

The cover aggregate shall show no evidence of disintegration nor show a total loss greater than 12% when subjected to five cycles of the sodium sulphate accelerated soundness test specified in ASTM C 88.

The crushed cover aggregate shall meet the requirements for gradation given in Table 1 when tested in accordance with ASTM C 136.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE

SIEVE DESIGNATION (SQUARE OPENINGS)	PERCENTAGE BY WEIGHT PASSING SIEVES
1/2 inch *(12.5 mm)*	100
3/8 inch *(9.5 mm)*	85-100
No. 4 *(4.75 mm)*	10-30
No. 8 *(2.36 mm)*	0-10
No. 16 *(1.18 mm)*	0-5
No. 200* *(0.075 mm)*	0-1

*Amount of material finer than No. 200 *(0.075 mm)* sieve shall be determined in accordance with ASTM C117.

The gradations in the table represent the limits which shall determine suitability of aggregate for use for the specified applications from the sources of supply. The final gradations decided on, within the limits designated in the table, shall be uniformly graded from coarse to fine.

The cover aggregate to be used shall show no evidence of stripping or swell when tested in accordance with AASHO T 182. The use of antistrip agents for the control of stripping shall be used if necessary.

609-2.2 BITUMINOUS MATERIAL. The bituminous material shall be Rapid Setting Emulsified Asphalt Grade RS-2, meeting the requirements of ASTM D-977. The material shall be applied at a temperature range of not less than 125° F *(52° C)* and not more than 175° F *(80° C)*.

CONSTRUCTION METHODS

609-3.1 WEATHER LIMITATIONS. Bituminous material shall be applied only when the existing surface is dry and the atmospheric temperature is above 60° F *(15.6° C)*. No material shall be applied when rain is imminent or when dust or sand is blowing.

The existing surface shall be free of surface moisture during the Contractor's operating periods.

The Architect/Engineer may require the Contractor to delay the application of bituminous material until the atmospheric and pavement surface conditions are satisfactory.

Whenever the atmospheric or existing surface conditions are marginal, or weather forecasts indicates such conditions are likely to occur, the Architect/Engineer may direct the Contractor to cease his operations.

609-3.2 OPERATION OF PITS AND QUARRIES. The aggregate material shall be produced and supplied by a Florida DOT approved aggregate pit or source located in Dade County area, and shall be subject to approval by the Architect/Engineer. The material in the pits shall be handled so that a uniform and satisfactory product shall be secured.

609-3.3 EQUIPMENT AND TOOLS. The Contractor shall furnish all equipment, tools, and machines necessary for the performance of the work. All equipment shall be subject to approval by the Architect/Engineer.

a. Pressure Distributor. The distributor shall have pneumatic tires of such width and number that the load produced on the pavement surface shall not exceed 650 pounds per inch of the tire width and it shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent. Distributor equipment shall include a tachometer, pressure gages, volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

b. Aggregate Spreader. The aggregate spreader shall be a self-propelled mechanical spreader or truck-attached mechanical spreader capable of uniformly distributing aggregate at the specified rates, producing an even spread at least 12' in width.

c. Pneumatic-tired Rollers. The pneumatic-tired rollers shall have an effective rolling width of at least 60 inches *(150 cms)* and capable of exerting a minimum contact pressure of 40 pounds per square inch *(276 k Pa)*.

d. Steel Wheel Rollers. All steel wheeled rollers shall be self-propelled 3 to 5 ton *(2720 to 4530 Kgs)* tandem type roller. The wheels on the roller shall be equipped with adjustable scrapers which shall be used when necessary to clean the wheel surfaces. Rollers shall be equipped with tanks and sprinkling apparatus which shall be used to keep the wheels wet and prevent the surfacing materials from sticking.

e. Power Broom. A power broom and a drag broom shall be provided for evenly spreading the cover aggregate and later removing loose material from the surface to be treated.

f. Equipment for handling aggregates and such auxiliary equipment as needed to perform the work.

609-3.4 PREPARING UNDERLYING COURSE. The surface of the underlying course shall be prepared, shaped, and conditioned to a uniform grade and section, as shown on the plans and as specified. Loose dust or dirt and other objectionable material shall be removed from the surface.

Where a prime coat is required and specified, the prime shall be applied and satisfactorily cured before starting the bituminous surface treatment.

609-3.5 APPLICATION OF BITUMINOUS MATERIAL. Bituminous material shall be uniformly applied upon the properly prepared surface at the rate and temperature specified using a pressure distributor to obtain uniform distribution at all points. To insure proper drainage, the strips shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope. During all applications, the surfaces of adjacent pavements or structures shall be protected in such manner as to prevent their being spattered or marred. Bituminous materials shall not be discharged into borrow pits or gutters or upon the airport area.

All exposed fixtures and structures in the pavement or shoulders and those that might be exposed to bituminous material during application shall be covered with a heavy duty polyethylene sheeting or bags or other approved method. Hand applications of bituminous material around certain fixtures or structures may be required.

609-3.6 APPLICATION OF AGGREGATE MATERIAL. Immediately after the application of the bituminous material, the aggregates at the rate designated by the Architect/Engineer shall be spread uniformly over the bituminous material. Equipment spreading aggregate shall be operated backward so that the bituminous material will be covered before the equipment wheels pass over it. The aggregate shall be spread in the same width of application as the bituminous material and shall not be applied in such thickness as to cause blanketing. Back-spotting or sprinkling of additional aggregate material, and pouring additional bituminous material over areas that show up having insufficient cover or bitumen, shall be done by hand whenever necessary. Additional spreading of aggregate material shall be done by means of a motor-patrol grader equipped with broom moldboard, a broom drag, or a power broom, as directed by the Architect/Engineer.

Aggregates shall be rolled immediately after spreading. A single initial pass with no overlap, using the steel-wheel roller, shall be made, to initially embed the aggregate material into the bituminous material. Additional spreading of aggregate material shall be done by means a towed broom drag attached to a power broom, as approved by the Architect/ Engineer. Following the initial rolling and broom dragging with the steel-wheel roller, the course shall be further rolled with a pneumatic roller to insure proper embedding of cover aggregate into the bitumen. The rolling shall be continued until no more aggregate material can be worked into the surface. Further rolling and brooming on the strip being placed and on adjacent strips previously placed, shall be continued until the surface is evenly covered and cured to the satisfaction of the Architect/Engineer.

The bituminous material and the aggregate shall be spread upon the clean and properly cured surface and handled as required. Extreme care shall be taken in all applications to avoid brooming or tracking dirt or any foreign matter on any portion of the pavement surface under construction.

All surplus aggregate resulting from the application shall be swept off the surface and removed prior to final acceptance of the work.

Bituminous concrete surface course shall not be applied until the bituminous surface treatment application has cured, but in no case less than 24 hours.

609-3.7 CORRECTION OF DEFECTS. Any defects, such as raveling, low centers, lack of uniformity, or other imperfections, shall be corrected to the satisfaction of the Architect/Engineer.

All defective materials resulting from over-heating, improper handling, or improper application shall be removed by the Contractor and replaced with approved materials as provided for in these specifications.

609-3.8 BITUMINOUS MATERIAL CONTRACTOR'S RESPONSIBILITY. Samples of the bituminous materials that the Contractor proposes to use, together with a statement as to their source and character, shall be submitted and the Architect/Engineer's approval obtained before use of such materials begins.

The Contractor shall furnish vendor's certified test reports for each carload, or equivalent, of bitumen shipped to the project. The report shall be delivered to the Architect/Engineer before permission is granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports shall be subject to verification by testing sample materials as received for use on the project.

FDOT test reports confirming compliance with the requirements of these Specifications may be accepted in lieu of the vendor's certified test reports.

609-3.9 FREIGHT AND WEIGH BILLS. Before the final Contractor's requisition for payment is processed, the Contractor shall file with the Architect/Engineer receipted bills where railroad shipments are made, and certified weight bills when materials are received in any other manner, of the bituminous and covering materials actually used in the construction work under this Section. The Contractor shall not remove bituminous material from the tank car or storage tank until the initial outage and temperature measurements have been taken by the Architect/Engineer, nor shall the car or tank be released until the final outage has been taken by the Architect/Engineer.

Copies of all freight bills and weigh bills shall be furnished to the Architect/Engineer during the progress of the work.

METHOD OF MEASUREMENT

609-4.1 Measurement of Bituminous Material-SST for payment shall be the number of (gallons) *(liters)* of bituminous materials actually used as approved by the Architect/Engineer and accepted in the work, corrected to 60° F *(15.6° C)*, in accordance with the temperature-volume correction Table IV-3 of the Asphalt Institute's Manual MS-6 for emulsified asphalt. Water added to emulsified asphalt will not be measured for payment.

609-4.2 Measurement of Aggregate-SST for payment shall be the number of (tons) *(kilograms)* used for the accepted work, as approved by the Architect/Engineer.

BASIS OF PAYMENT

609-5 Payment for accepted quantity of Bituminous Material-SST measured as described above shall be made at the Contract Unit Price per (gallon) *(liter)* for bituminous material (single surface treatment), and payment for accepted quantity of Aggregate-SST measured as described above shall be made at the contract unit price per (Ton) *(Kg)* for aggregate-SST. These prices and payments shall be full compensation for furnishing all materials and for all preparation, hauling and application of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the work under this Section.

Payment will be made under:

Item No.	Bituminous Material - SST -- per (gallon) *(liter)*
Item No.	Aggregate - SST -- per (ton) *(kgs)*

TESTING REQUIREMENTS

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Material Finer than No. 200 Sieve in Mineral Aggregates by Washing
ASTM C131	Test for Resistance to Abrasion of Small Size Aggregate by the Use of the Los Angeles Machine.
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
AASHTO T 182	Coating and Stripping of Bituminous Aggregate Mixtures

MATERIAL REQUIREMENTS

ASTM D977	Emulsified Asphalt
Asphalt Institute Manual MS-6 Table IV-3	Temperature-Volume Corrections for Emulsified Asphalt

END OF SECTION

Item P-610S
Concrete for Miscellaneous Structures
SUPPLEMENT

The work to be performed under the classification of STRUCTURAL PORTLAND CEMENT CONCRETE shall meet the requirements of Section P-610 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

REPLACE the title of this Section to: Concrete for Miscellaneous Structures

DESCRIPTION

MATERIALS

CONSTRUCTION METHODS

Delete the Master Proportion Table in article 610-3.1and Insert the following table:

MASTER PROPORTION TABLE

Using U.S. Units of Measure

CLASS	GRADE OF COARSE AGGREGATE	WATER/CEMENT FACTOR LBS./LB.	MIN. CEMENT FACTOR * LBS./C.Y.	SLUMP INCHES	MINIMUM COMPRESSIVE STRENGTH
I	57	0.55	508	2 1/2±1	2,500 psi
II	57	0.45	564	2 1/2±1	4,000 psi
III	57	0.50	611	2 1/2±1	5,000 psi
IV	57	0.40	658	2 1/2±1	5,500 psi

* For cast-in-place concrete placed under water, increase the minimum cement factor by 15%, in accordance with the requirements of Section P-710.

ADD article 610-3.20 **COLD WEATHER PLACING**

610-3.20 Cold weather placing. When concrete is placed at temperatures below 40°F (4°C), follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

ADD article 610-3.21 **HOT WEATHER PLACING**

610-3.21 Hot weather placing. When concrete is placed in hot weather greater than 85ºF (30 ºC), follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

ADD article 610-3.22 **QUALITY ASSURANCE SAMPLING AND TESTING**

610-3.22 Quality Assurance sampling and testing. Concrete for each day's placement will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The Engineer will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

Number of test cylinders and the frequency of sampling and testing will be as determined by the Engineer, per the following minimum standards:

1. Frequency of Testing:

   a. Not less than three (3) specimens shall be made for each standard test.

   b. Samples for strength of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete nor less than once for each 5000 sq. ft. of surface area for slabs or walls.

   c. On a single project, if total volume of concrete is such that frequency of testing required by Subparagraph 610-4.1.b hereinabove would provide less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected batches or from each batch if fewer than 5 batches are used.

   d. Test cylinders taken on truck-mixed concrete shall be taken at the approximate ¼ point and ¾ point of the load.

2. Laboratory-Cured Specimens:

   a. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28-days or at test age designated for determination of f’c.

   b. Samples of strength tests shall be taken in accordance with the Method of Sampling Fresh Concrete, ASTM C172.

   c. Cylinders for strength tests shall be molded and laboratory-cured in accordance with the Method Of Making and Curing Concrete Test Specimens in the Field, ASTM C31, and tested in accordance with the Method of Test for Compressive Strength of Cylindrical Concrete Specimens, ASTM C39.

   d. The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

      (1) Average of all sets of 3 consecutive strength tests equals or exceeds f’c.

      (2) No individual strength test (average of 2 cylinders) falls below f’c by more than 500 psi.

   e. If any of the requirements of Subsection 610-4.1.d herein are not met, steps shall be taken to increase the average of subsequent strength test results. Requirements of Paragraph 610-4.1.3 hereinbelow shall be observed if any individual strength test falls below f’c by more than 500 psi.

3. Investigation of Low-Strength Test Results:

   a. When low-strength tests or other factors raise a question as to the quality of the concrete in a structure, the County, through the Architect/Engineer, may require core tests in accordance with the Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM C42, or order load tests on the portion of the structure where the questionable concrete has been placed.

   b. When concrete in a structure has failed to meet the minimum standard, the County, through the Architect/Engineer, shall order analysis and reports by a qualified Registered Engineer to determine the adequacy of the structure.

c. If the likelihood of low-strength concrete is confirmed and computations indicate that load-carrying capacity may have been significantly reduced, test of cores drilled from the area in question may be required in accordance with the Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM C42. In such case, 3 cores shall be taken for each strength test more than 500 psi below specified value of f'c.

d. If the concrete in the structure will be dry under service conditions, cores shall be air dried at a temperature between 60F and 80F and a relative humidity less than 60% for 7 days before testing and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and shall be tested wet.

e. Concrete in an area represented by core tests shall be considered structurally adequate if the average of three core tests is equal to 85% of f'c and if no single core test is less than 75% of f'c. To check testing accuracy, locations represented by erratic core strengths may be retested.

The Contractor shall provide the concrete for the test specimens, cure and store the test specimens under such conditions as directed. The Project Testing Laboratory will furnish the cylinder molds, prepare the cylinders, transport the specimens to the laboratory and make the actual tests on the specimens at no expense to the Contractor.

METHOD OF MEASUREMENT

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates

ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

American Concrete Institute (ACI)

ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308R	Guide to External Curing of Concrete
ACI 309R	Guide for Consolidation of Concrete

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SECTION P-610
STRUCTURAL PORTLAND CEMENT CONCRETE

DESCRIPTION

610-1.1 The work under this Section consists of either plain or reinforced structural Portland cement concrete for constructing underground structures, prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the plans. Underground structures include but are not necessarily limited to catch basins, grit chambers, oil/water separators, inlets, valve pits, manholes, vaults, culverts, retaining walls, headwalls and other drainage and utility structures.

610-1.2 RESPONSIBILITY. The Contractor shall be solely responsible for all work performed including preparation of the mix design, manufacture and placement of Portland cement concrete, Contractor's Quality Control (QC) procedures and testing performed under this Section.

The Architect/Engineer will be responsible to the County for all Quality Assurance (QA) requirements, including inspections, acceptance testing and all other duties of the Architect/Engineer described in this Section. The Architect/Engineer will direct a County approved Independent Testing Laboratory (referred to herein, as the Project Testing Laboratory) to perform certain of the duties assigned to the Architect/Engineer. The Contractor shall refer all matters requiring approval or technical interpretations to the Architect/ Engineer, except for those certain specific matters wherein the Architect/ Engineer has designated the Project Testing Laboratory as the operating agent of the Architect/Engineer.

610-1.3 TESTING AND INSPECTION. The Architect/Engineer and his authorized representatives shall have free access, at all times, to all parts of the concrete producing plant(s), the Contractor's testing laboratory, stockpiles, storage facilities, and other facilities and equipment employed by the Contractor in connection with the construction work under this Section in order for the Architect/Engineer to verify the Contractor's compliance with the specification requirements.

The County will arrange for the Project Testing Laboratory to perform tests necessary to verify the Contractor's job mix proportions, quality of aggregates, plant production and to perform acceptance testing for the work.

The Contractor shall perform all job mix proportions design, plant control, construction control, and other quality control tests required of the Contractor by these Specifications.

The Contractor shall perform all quality control tests in the Contractor's testing laboratory. The Contractor shall also provide concrete for the sampling and testing to be performed by the Project Testing Laboratory. All tests necessary for the County to confirm conformance with specification requirements prescribed herein for acceptance and payment purposes will be performed and reported independently by the Project Testing Laboratory. The Contractor may witness the testing procedures of the Project Testing Laboratory and participate in these procedures to assure mutual agreement on test results. In like manner, the Project Testing Laboratory may observe and participate in testing performed by the Contractor's testing technician. If mutual agreement as to test results is not achieved, both the Contractor and the Project Testing Laboratory shall report their results separately to the Architect/Engineer.

Acceptance of work performed under this Section, shall be based solely on the reports of the Project Testing Laboratory. The Architect/Engineer may conditionally accept work performed based on the Contractor's testing results and reports, but such conditional acceptance shall not prevent subsequent rejection of the material if the reports of the Project Testing Laboratory show that the work performed failed to meet specifications requirements.

MATERIALS

610-2.1 GENERAL. Only approved materials, conforming to the requirements of these specifications, shall be used in the work. They may be subjected to inspection and tests at any time during the progress of their preparation or use. The source of supply of each of the materials shall be approved by the Architect/Engineer before delivery or use is started. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to insure the preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed therein.

In no case shall the use of pit-run or naturally mixed aggregates be permitted. Naturally mixed aggregate shall be screened and washed, and all fine and coarse aggregates shall be stored separately and kept clean. The mixing of different kinds of aggregates from different sources in one storage pile or alternating batches of different aggregates will not be permitted.

610-2.2 COARSE AGGREGATE. The coarse aggregate for concrete shall meet the requirements of ASTM C33. The percentage of wear shall be not more than 45 at 500 revolutions as determined by ASTM C131.

Coarse aggregate shall be well graded from coarse to fine and shall meet one of the following gradations when tested in accordance with ASTM C136.

COARSE AGGREGATE - GRADATION

Percent Passing by Weight

SIEVE SIZE	SIZE NO. 8*	SIZE NO. 57	SIZE NO. 67
1 1/2" *(37.5 mm)*	---	100	---
1" *(25.0 mm)*	---	95 to 100	100
3/4" *(19.0 mm)*	---	---	90 to 100
1/2" *(12.5 mm)*	100	25 to 60	---
3/8" *(9.5 mm)*	85 to 100	---	20 to 55
#4 *(4.75 mm)*	10 to 30	0 to 10	0 to 10
#8 *(2.36 mm)*	0 to 10	0 to 5	0 to 5
#16 *(1.18 mm)*	0 to 5	---	---

*To be used only when directed or approved by the Architect/Engineer.

610-2.3 FINE AGGREGATE. The fine aggregate for concrete shall meet the requirements of ASTM C33.

The fine aggregate shall be Quartz sand or Miami Oolitic Rock Screenings, shall be well graded from fine to coarse, and shall meet the following grading requirements when tested in accordance with ASTM C136.

FINE AGGREGATE - GRADATIONS

Sieve Size	Percent Passing by Weight
3/8" *(9.5 mm)*	100
#4 *(4.75 mm)*	95 to 100
#8 *(2.36 mm)*	80 to 100
#16 *(1.18 mm)*	50 to 85
#30 *(0.60 mm)*	25 to 60
#50 *(0.30 mm)*	10 to 30
#100 *(0.150 mm)*	2 to 10

For Miami Oolite Rock Screenings used as fine aggregate, the specific gravity (saturated surface dry) shall be at least 2.48.

Blending will be permitted, if necessary, in order to meet the gradation requirements for fine aggregate. Fine aggregate deficient in the percentage of material passing the No. 50 mesh *(0.30 mm)* sieve may be accepted, provided that such deficiency does not exceed 5% and is remedied by the addition of pozzolanic or cementitious materials other than Portland cement, as specified in 610-2.6 on admixtures, in sufficient quantity to produce the required workability as approved by the Architect/Engineer.

610-2.4 CEMENT. Cement shall conform to the requirements of ASTM C150 Type I, Type II, or Type III. The use of air entrained cements is not permitted.

Type III cement may only be used in Class III or Class IV concrete, subject to approval by the Architect/Engineer.

The Contractor shall furnish vendors' certified test reports for each carload, or equivalent, of cement shipped to the project. The report shall be delivered to the Architect/Engineer before permission to use the cement is granted. All such test reports shall be subject to verification by testing sample materials received for use on the project.

610-2.5 WATER. The water used in concrete shall be free from sewage, oil, acid, strong alkalies, vegetable matter, clay or loam. If the water is of questionable quality, it shall be tested in accordance with AASHTO T 26.

610-2.6 ADMIXTURES. The use of any material added to the concrete mix shall be approved by the Architect/Engineer. Before approval of any material, the Contractor shall be required to submit the results of complete physical and chemical analyses made by an acceptable testing laboratory. Subsequent tests shall be made of samples taken by the Project Testing Laboratory from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved. Admixtures proposed to be used must be on the current list of approved admixtures maintained by the Florida Department of Transportation. Such listings are on file with the office of Value Engineering in Tallahassee, Florida.

Pozzolanic admixtures shall be fly ash or raw or calcined natural pozzolons meeting the requirements of ASTM C618, Type C or Type F with the exception of loss of ignition, where the maximum should be less than 6 percent.

Air-entraining admixtures shall meet the requirements of ASTM C260. Air-entraining admixtures shall be added at the mixer in the amount necessary to produce the specified air content.

Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, Type A, water-reducing or Type D, water-reducing and retarding. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions.

Care shall be taken with the combined use of admixtures as they individually and cumulatively may contribute to the air content of the concrete. All admixtures shall be the product of the same manufacturer to ensure chemical compatibility with each other.

The adding of calcium chloride to a concrete mix is not permitted.

610-2.7 PREMOLDED JOINT MATERIAL. Premolded joint material for expansion joints shall meet the requirements of ASTM D1752, Type I.

610-2.8 JOINT FILLER. The filler for joints shall meet the requirements of ~~Item~~ ***Section*** P-605, unless otherwise specified.

610-2.9 STEEL REINFORCEMENT. Reinforcing shall consist of deformed steel bars conforming to the requirements of ASTM A615, Grade 60 *(ASTM A615M, Grade 400)* or welded deformed steel fabric conforming to the requirements of ASTM A497, as shown on the Plans.

610-2.10 WATERSTOPS. Waterstops shall be extruded from polyvinyl chloride meeting the requirements of Corps of Engineers Specifications CRD-C578; shape and size shall be as shown on the Plans and subject to the Architect/Engineer's approval.

610-2.11 NON-SHRINK GROUT. Non-shrink grout shall be Sika Grout 212 as manufactured by Sika Corporation, 5 Star Grout as manufactured by U.S. Grout Corp., or Masterflow 713 as manufactured by Master Builders or approved equal. Only non-shrink, non-metallic grouts shall be used and any used must be approved by the Architect/Engineer in writing prior to construction.

610-2.12 COVER MATERIALS FOR CURING. Curing materials shall conform to one of the following specifications:

Burlap cloth made from jute or kenaf	AASHTO M 182
Liquid Membrane-Forming Compounds for Curing Concrete, pigmented white	ASTM C309, Type 2

CONSTRUCTION METHODS

610-3.1 GENERAL. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the Plans drawings and specified herein. All machinery and equipment owned or controlled by the Contractor, which he proposes to use on the work, shall be of sufficient size to meet the requirements of the work, and shall be such as to produce satisfactory work; all work shall be subject to the inspection and approval of the Architect/Engineer.

610-3.2 CONCRETE PROPORTIONS. Concrete shall be Class I, Class II, Class III, or Class IV, as required, meeting the following requirements:

MASTER PROPORTION TABLE

Using U.S. Units of Measure

CLASS	GRADE OF COARSE AGGREGATE	WATER/CEMENT FACTOR LBS./LB.	MIN. CEMENT FACTOR * LBS./C.Y.	SLUMP INCHES	MINIMUM COMPRESSIVE STRENGTH
I	57	0.55	508	2 1/2±1	2,500 psi
II	57	0.49	564	2 1/2±1	3,400 psi
III	57	0.50	611	2 1/2±1	5,000 psi
IV	57	0.41	658	2 1/2±1	5,500 psi

* For cast-in-place concrete placed under water, increase the minimum cement factor by 15%, in accordance with the requirements of Section P-710.

Using S.I. Units of Measure

CLASS	*GRADE OF COARSE AGGREGATE*	*WATER/CEMENT FACTOR Kgs/Kg*	*MIN. CEMENT FACTOR * Kgs/m³*	*SLUMP mms*	*MINIMUM COMPRESSIVE STRENGTH*
I	*57*	*0.55*	*301*	*63±25*	*17,235 kPa*
II	*57*	*0.49*	*335*	*63±25*	*23,445 kPa*
III	*57*	*0.50*	*363*	*63±25*	*34,475 kPa*
IV	*57*	*0.41*	*390*	*63±25*	*37,925 kPa*

* For cast-in-place concrete placed under water, increase the minimum cement factor by 15%, in accordance with the requirements of Section P-710.

The Contractor shall be required to designate the actual proportions for each mix to be used in order to produce a concrete of the strength required.

Prior to mixing any concrete, the Contractor shall submit his design mix for approval. Only mixes approved by the Architect/Engineer shall be incorporated into the work. Should a change in sources of material or the aggregate gradations be made, a new mix design must be established and approved before the new material is used.

The Contractor may submit a mix based on Grade 8 Coarse Aggregate if all other requirements are met at the discretion of the Architect/Engineer.

Class I concrete shall only be used for fence post footings, thrust blocks, pipe cradles, and for backfill around underground structures.

Class IV concrete shall be used for prestressed concrete construction and other structures requiring high strength concrete construction.

A 3-6% air entrainment by volume will be required in all Class II, Class III, and Class IV concrete, unless otherwise specified or ordered by the Architect/Engineer. Air entrainment shall be produced by the addition of the air entraining admixture to the mixing water during batching.

The Contractor shall designate, in advance, the particular type, product, and amount of each admixture he proposes to use and only such admixtures and dosage that are approved by the Architect/Engineer shall be incorporated into the concrete. Admixtures designated by the Contractor shall be compatible to all other components of the concrete. When retardant admixtures are used, they shall be added with the mixing water.

610-3.3 ACCEPTANCE SAMPLING AND TESTING. Concrete will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The concrete shall be sampled in accordance with ASTM C172. Compressive strength specimens (cylinders) shall be made in accordance with ASTM C31 and tested in accordance with ASTM C39. Number of test cylinders and the frequency of sampling and testing will be as determined by the Architect/Engineer, per the following minimum standards:

1. Frequency of Testing:

    a. Not less than three (3) specimens shall be made for each standard test.

    b. Samples for strength of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete nor less than once for each 5000 sq. ft. of surface area for slabs or walls.

    c. On a single project, if total volume of concrete is such that frequency of testing required by Subparagraph 610-3.3.1.b hereinabove would provide less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected batches or from each batch if fewer than 5 batches are used.

    d. Test cylinders taken on truck-mixed concrete shall be taken at the approximate ¼ point and ¾ point of the load.

2. Laboratory-Cured Specimens:

    a. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28-days or at test age designated for determination of f'_c.

    b. Samples of strength tests shall be taken in accordance with the

Method of Sampling Fresh Concrete, ASTM C172.

c. Cylinders for strength tests shall be molded and laboratory-cured in accordance with the Method Of Making and Curing Concrete Test Specimens in the Field, ASTM C31, and tested in accordance with the Method of Test for Compressive Strength of Cylindrical Concrete Specimens, ASTM C39.

d. The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

(1) Average of all sets of 3 consecutive strength tests equals or exceeds f'_c.

(2) No individual strength test (average of 2 cylinders) falls below f'_c by more than 500 psi.

e. If any of the requirements of Subsection 610-3.3.d herein are not met, steps shall be taken to increase the average of subsequent strength test results. Requirements of Paragraph 610-3.3.3 hereinbelow shall be observed if any individual strength test falls below f'_c by more than 500 psi.

3. Investigation of Low-Strength Test Results:

a. When low-strength tests or other factors raise a question as to the quality of the concrete in a structure, the County, through the Architect/Engineer, may require core tests in accordance with the Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM C42, or order load tests on the portion of the structure where the questionable concrete has been placed.

b. When concrete in a structure has failed to meet the minimum standard, the County, through the Architect/Engineer, shall order analysis and reports by a qualified Registered Engineer to determine the adequacy of the structure.

c. If the likelihood of low-strength concrete is confirmed and computations indicate that load-carrying capacity may have been significantly reduced, test of cores drilled from the area in question may be required in accordance with the Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM C42. In such case, 3 cores shall be taken for each strength test more than 500 psi below specified value of f'_c.

d. If the concrete in the structure will be dry under service conditions, cores shall be air dried at a temperature between 60^o F and 80^o F and a relative humidity less than 60% for 7 days before testing and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and shall be tested wet.

e. Concrete in an area represented by core tests shall be considered structurally adequate if the average of three core tests is equal to

85% of f'_c and if no single core test is less than 75% of f'_c. To check testing accuracy, locations represented by erratic core strengths may be retested.

The Contractor shall provide the concrete for the test specimens, cure and store the test specimens under such conditions as directed. The Project Testing Laboratory will furnish the cylinder molds, prepare the cylinders, transport the specimen***s*** to the laboratory and make the actual tests on the specimens at no expense to the Contractor.

610-3.4 PROPORTIONING AND MEASURING DEVICES. When package cement is used, the quantity for each batch shall be equal to one or more whole sacks of cement. The aggregates shall be measured separately by weight. If aggregates are delivered to the mixer in batch trucks, the exact amount for each mixer charge shall be contained in each batch compartment. Weighing boxes or hoppers shall be approved by the Architect/Engineer and shall provide means of regulating the flow of aggregates into the batch box so that the required and exact weight of aggregates can be readily obtained.

610-3.5 CONSISTENCY. The consistency of the concrete shall be checked by the slump test specified in ASTM C143.

610-3.6 MIXING. Concrete may be mixed at the construction site, at a central plant, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94.

610-3.7 MIXING AND DELIVERY. The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40° F *(4° C)* without permission of the Architect/Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50° F *(10° C)* nor more than 100° F *(38° C)*. The Contractor shall be held responsible for any defective work resulting from freezing or injury in any manner during placing and curing and shall replace such work at his/her expense.

Retempering of concrete by adding water or any other material shall not be permitted.

The delivery of concrete to the job shall be in such a manner that batches of concrete will be deposited at uninterrupted intervals.

When the atmospheric temperature is 95° F *(35° C)* or higher or is forecast to rise above that temperature within 24 hours of the time concrete is placed, the Architect/ Engineer may prohibit concrete work. During periods of warm weather when the maximum daily air temperature exceeds 80° F *(27° C)* placing concrete shall be performed in accordance with the recommendations of ACI 305R.

The manufacturer of ready-mix concrete shall furnish to the Architect/Engineer (or CIS Inspector/Owner's representative) with each batch of concrete, before unloading at the site, a delivery ticket on which is printed, stamped or written, the concrete manufacturer's standard information about the concrete being delivered.

In addition to the concrete manufacturer's standard delivery ticket, the manufacturer shall furnish to the Architect/Engineer (or CIS Inspector/Owner's Representative) with each load of concrete before unloading at the site a "Concrete Certification Form" on which is printed, stamped or written the following information:

1. Name of ready-mix batch plant
2. Serial number of ticket
3. Date and truck number
4. Name of Contractor
5. Contract Number
6. Specific class or designation of concrete
7. Quantity of concrete in Cubic Yards
8. Time loaded, or of first mixing of cement and aggregate
9. Water content in gallons by producer's batch plant at specified maximum W/C ratio
10. Batch Plant mixing water withheld from the maximum W/C ratio requirement
11.* Specified slump (including tolerance)in inches; slump on arrival at jobsite in inches
12. Amount of water in gallons added at jobsite with the approval of the receiver** of concrete (if any), the time it was added, and the receiver's initials certifying compliance with the producer's maximum water content limits as stated on the ticket
13. Total water content
14. Type and name of admixture, and amount of same
15. Type and brand of cement
16. Amount of cement
17. Maximum size of aggregate
18. Weight of fine and of coarse aggregate
19. Mixing time, or reading of revolution counter at beginning and end of mixing period
20. Certification by concrete receiver's initials that all ingredients and mix proportions comply with those previously approved for subject contract
21. Signature or initial of ready-mix representative.

* If no water is added, the result of the slump test by the project testing laboratory may be entered in lieu of "slump on arrival at jobsite."

** Receiver shall be MDAD's authorized representative, who may be the project A/E, CIS Inspector or other individual so authorized.

610-3.8 FORMS. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Architect/Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the Plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The Contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes.

The internal ties shall be arranged so that, when the forms are removed, no metal will show in the concrete surface or discolor the surface when exposed to weathering. All forms shall be wetted with water or with a nonstaining mineral oil which shall be applied shortly before the concrete is placed. Forms shall be constructed so that they can be removed without injuring the concrete or concrete surface. The forms shall not be removed before the expiration of at least 30 hours from vertical faces, walls, slender columns, and similar structures; forms supported by falsework under slabs, beams, girders, arches, and similar construction shall not be removed until the time specified in ACI 347 has elapsed or the tests indicate that at least 60% of the design strength of the concrete has developed, whichever is later, unless otherwise directed by the Architect/Engineer in writing.

610-3.9 PLACING REINFORCEMENT. All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concreting. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

610-3.10 EMBEDDED ITEMS. Before placing concrete, any items that are to be embedded shall be firmly and securely fastened in place. All such items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The embedding of wood is prohibited. The concrete shall be spaded and consolidated around and against embedded items.

610-3.11 PLACING CONCRETE. All concrete shall be placed during daylight, unless otherwise approved. The concrete shall not be placed until the depth and character of foundation, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved. Concrete shall be placed as soon as practical after mixing and in no case later than 1 hour after water has been added to the mix. The method and manner of placing shall be such as to avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. Dropping the concrete a distance of more than 5 feet, or depositing a large quantity at one point, will not be permitted. Concrete shall be placed upon clean, damp surfaces, free from running water, or upon properly consolidated soil.

The concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When necessary, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction. Vibrators shall be manipulated so as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to the point where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket, or other approved method and shall not be disturbed after being deposited.

610-3.12 CONSTRUCTION JOINTS. When the placing of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be prescribed. The work shall be arranged so that a section begun on any day shall be finished during daylight of the same day. Before depositing new concrete on or against concrete which has hardened, the surface of the hardened concrete shall be cleaned by a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

610-3.13 EXPANSION JOINTS. Expansion joints shall be constructed at such points and of such dimensions as may be indicated on the Plans. The premolded filler shall be cut to the same shape as that of the surfaces being joined. The filler shall be fixed firmly against the surface of the concrete already in place in such manner that it will not be displaced when concrete is deposited against it.

610-3.14 DEFECTIVE WORK. Any defective work disclosed after the forms have been removed shall be immediately removed and replaced. If any dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb, which in the opinion of the Architect/Engineer cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

610-3.15 SURFACE FINISH. All exposed concrete surfaces shall be true, smooth, free from open or rough spaces, depressions, or projections. The concrete in horizontal plane surfaces shall be brought flush with the finished top surface at the proper elevation and shall be struck-off with a straightedge and floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

When directed, the surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, the surface shall be pointed and wetted and then rubbed with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, a carborundum stone shall be used to finish the surface. When approved, the finishing can be done with a rubbing machine.

610-3.16 CURING AND PROTECTION. All concrete shall be properly cured and protected by the Contractor. The work shall be protected from the elements, flowing water, and from defacement of any nature during the building operations.

The concrete shall be cured as soon as it has sufficiently hardened by covering with an approved material. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for a period of at least 3 days. All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to currents of air. Where wooden forms are used, they shall be kept wet at all times until removed to prevent the opening of joints and drying out of the concrete. Traffic shall not be allowed on concrete surfaces for 7 days after the concrete has been placed.

610-3.17 DRAINS OR DUCTS. Drainage pipes, conduits, and ducts that are to be encased in concrete shall be installed by the Contractor before the concrete is placed. The pipe shall be held rigidly so that it will not be displaced or moved during the placing of the concrete.

610-3.18 NUMBER LEFT BLANK INTENTIONALLY

610-3.19 FILLING JOINTS. All joints that require filling shall be thoroughly cleaned, and any excess mortar or concrete shall be cut out with proper tools. Joint filling shall not be started until after final curing and shall be done only when the concrete is completely dry. The cleaning and filling shall be carefully done in accordance with the applicable requirements of Section P-605, using proper equipment and in a manner to obtain a neat looking joint, free from excess filler.

METHOD OF MEASUREMENT

610-4 Structural Portland cement concrete, including reinforcement, shall not be measured separately for payment as it is considered incidental to the structure for which it is intended.

TESTING REQUIREMENTS

ASTM C31	Making and Curing Test Specimens in the Field
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C131	Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM C138	Unit Weight, Yield, and Air Content of Concrete
ASTM C143	Slump of Portland Cement Concrete
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T26	Water

MATERIAL REQUIREMENTS

ASTM A497	Specification for Welded Deformed Steel Wire Fabric for Concrete Pavement
ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C33	Concrete Aggregates
ASTM C94	Ready-Mixed Concrete
ASTM C150	Portland Cement
AASHTO M182	Burlap Cloth for Curing Concrete
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures
ASTM C618	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a

Mineral Admixture in Portland Cement Concrete

ASTM D1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ACI 305R	Hot Weather Concreting
ACI 347	Concrete Formwork

END OF SECTION

Item P-620S
Runway and Taxiway Marking

SUPPLEMENT

The work to be performed under the classification of RUNWAY AND TAXIWAY PAINTING shall meet the requirements of Section P-620 of the Miami-Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified in this Supplement.

REPLACE the title of this Section to: **RUNWAY AND TAXIWAY MARKING**

DELETE the entire specification and INSERT the following:

DESCRIPTION

620-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative. The terms "paint" and "marking material" as well as "painting" and "application of markings" are interchangeable throughout this specification.

MATERIALS

620-2.1 Materials acceptance. The Contractor shall furnish manufacturer's certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer's surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Resident Project Representative (ENGINEER) prior to the initial application of markings. The reports can be used for material acceptance or the ENGINEER may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the ENGINEER upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the ENGINEER.

620-2.2 Marking materials.

Table 1. Marking Materials

Paint[1]				Glass Beads[2]	
Type	**Color**	**Fed Std. 595 Number**	**Application Rate Maximum**	**Type**	**Application Rate Minimum**
Waterborne Type II	White	37925	115 ft2/gal	Type III	10 lb/gal
Waterborne Type II	Yellow	33538 or 33655	115 ft2/gal	Type III	10 lb/gal
Waterborne Type II	Red	31136	115 ft2/gal	Type I	7 lb/gal
Waterborne Type II	Black	37038	115 ft2/gal		
Waterborne Type II	Pink	1 part 31136 to 2 parts 37925	115 ft2/gal	Type I	7 lb/gal
Temporary Marking Waterborne Type I or II			230 ft2/gal	Type III	3 lb/gal

[1] **See paragraph 620-2.2a**

[2] **See paragraph 620-2.2b**

Waterborne black paint shall be used to outline a border at least 6-inches wide around all markings of other colors.

a. Paint. Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

Waterborne . Paint shall meet the requirements of Federal Specification TT-P-1952F, Type II. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis.

b. Reflective media. Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type I, Gradation A and Type III.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

Glass beads shall be treated with adhesion promoting and/or flotation coatings. The Retroreflective readings at application should meet values ranging from 700 to 1100 millicandellas on the white markings and 400 to 900 millicandellas on yellow markings.

The Contractor must always apply glass beads to white (runway) and yellow (taxiway).

c. Preformed Thermoplastic Airport Pavement Markings. Markings must be composed of ester modified resins in conjunction with aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.

(1) The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.

(a) The markings must be supplied with an integral, non-reflectorized black border.

(2) Graded glass beads.

(a) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to Federal Specification TT-B-1325D, Type I, gradation A and Federal Specification TT-B-1325D, Type IV.

(b) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb (0.45 kg) (±10%) per 10 square feet (1 sq m). These factory-applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

Preformed Thermoplastic Bead Gradation

Size Gradation		Retained, %	Passing, %
U.S. Mesh	µm		
12	1700	0 - 2	98 - 100
14	1400	0 - 3.5	96.5 - 100
16	1180	2 - 25	75 - 98
18	1000	28 - 63	37 - 72
20	850	63 - 72	28 - 37
30	600	67 - 77	23 - 33
50	300	89 - 95	5 - 11
80	200	97 - 100	0 - 3

(3) Heating indicators. The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment during application and that the installation procedures have been followed.

(4) Pigments. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.
- Organic yellow, other colors, and tinting as required to meet color standard.

(5) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(6) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

(7) Skid resistance. The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

(8) Thickness. The material must be supplied at a nominal thickness of 65 mil (1.7 mm).

(9) Environmental resistance. The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

(10) Retroreflectivity. The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

(11) Packaging. Packaging shall protect the material from environmental conditions until installation.

(12) Preformed thermoplastic airport pavement marking requirements.

(a) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement concrete pavements by the use of a large radiant heater. Colors shall be available as required.

(b) The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per advisory circular (AC) 150/5320-12, current version. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.

(c) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet (6 m) long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.

(d) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.

(e) The marking material shall have an integral color throughout the thickness of the marking material.

CONSTRUCTION METHODS

620-3.1 Weather limitations. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

620-3.2 Equipment. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

620-3.3 Preparation of surfaces. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminates that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the ENGINEER. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

a. Preparation of new pavement surfaces. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the ENGINEER to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

b. Preparation of pavement to remove existing markings. Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the ENGINEER minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

c. Preparation of pavement markings prior to remarking. Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the ENGINEER. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the ENGINEER prior to the initial application of markings.

d. Remarking. When the Engineer or the MDAD Operations determines that the existing paint does not have to be removed, the Contractor must remove all loose markings before applying new paint.

620-3.4 Layout of markings. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

620-3.5 Application. A period of **30** days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the ENGINEER.

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacing shall be within the following tolerances:

Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

620-3.6 Application--preformed thermoplastic airport pavement markings.

To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet (5 m) and a free span between supporting wheels of no less than 18 feet (5.5 m). The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of 2 inches (50 mm) wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F (2°C) without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centiPoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package.

620-3.7 Control strip. Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the ENGINEER. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620-3.8 Retro-reflectance. Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m²/lux		
	White	**Yellow**	**Red**
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than[1]	100	75	10

[1] 'Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

620-3.9 Protection and cleanup. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the ENGINEER. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

620-3.10 Temporary Markings. All temporary markings shall be of the same width, color, and applied at the locations shown in the plans or as directed by the engineer.

The paint for temporary markings shall be applied at 50% of the application rate as shown in table 1. Type I, Gradation A Glass beads shall also be applied at the application rate per Table 1.

Markings may be required before paving operations are complete. Operation may need to temporary markings to allow for opening the runway and taxiways between phases. The Contractor must apply the glass beads with care and at slower pace because they will not adhere well at the low application rates for temporary markings.

620-3.11 Markings Removal. As shown in the plans or directed by the Engineer or MDAD, the Contractor must remove the markings on asphalt or concrete surfaces. The paint shall be completely removed by air or water blasting, or another MDAD approved method. MDAD may authorize painting over with grey paint at temporary locations. When directed by the Engineer , disturbed pavement shall be surfaced treated.

METHOD OF MEASUREMENT

620-4.1 The quantity of runway and taxiway permanent markings to be paid for shall be the number of square foot of painting performed in accordance with the specifications and accepted by the Engineer. Associated surface preparation is incidental to the pavement markings.

620-4.1a The quantity of existing runway and taxiway markings removal to be paid for shall be the number of square foot of existing marking removed in accordance with the plans and specifications and accepted by the Engineer.

BASIS OF PAYMENT

620-5. Payment shall be made at the respective contract price per square foot for runway and taxiway permanent painting and associated surface preparation and for removal of existing taxiway and runway markings. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-620-5.1	Marking Removal - per square foot
Item P-620-5.2	Pavement Marking, Reflective (White) – per square foot
Item P-620-5.3	Pavement Marking, Reflective (Yellow) – per square foot.
Item P-620-5.4	Pavement Marking, Non-Reflective (Black) – per square foot
Item P-620-5.5	Preformed Thermoplastic Marking – per square foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication

Federal Specifications (FED SPEC)

FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
FED STD 595	Colors used in Government Procurement

Commercial Item Description

A-A-2886B	Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1	Standards for Airport Markings
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

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SECTION P-620
RUNWAY AND TAXIWAY PAINTING

DESCRIPTION

620-1 The work under this Section consist of the painting of numbers, markings, and stripings on the surface of airfield pavement applied in accordance with these specifications and at the locations shown on the Plans, or as directed by the **Architect/**Engineer.

The work shall also include the application of temporary striping tape and the removal of existing markings on airfield pavement surfaces.

Airfield pavement surfaces include runway, taxiways, taxilanes, shoulders, maintenance and terminal aprons and blast protection pavement.

MATERIALS

620-2.1 PAINT. Paint shall meet the following requirements:

a. White and Yellow Airfield Paint. The white and yellow airfield paint used on asphalt pavements or blast protection paving and for temporary striping between layers of bituminous pavement overlays shall be Water Emulsion Base Paint meeting Federal Specification TT-P-1952.

b. The paint used on Portland Cement concrete aprons shall be a two part Polyurethane Paint meeting Military Specifications MIL-C-83286, MIL-C-46168 and MIL-C-81773C, and equal to Rustoleum Products "Rustothane" #9448 or a two component epoxy-phenolic resin and amine adduct curing agent equal to SOMAY/VALSPAR "stripers choice" #9-101.

c. Traffic Marking Paint. The traffic marking paint used for Emergency Vehicle routes abutting terminal concourses shall be Rubber Base Paint meeting Federal Specification TT-P-115, Type II; color shall be as shown on the Plans.

d. Runway Marking and Striping Paint. The paint for runway marking and striping shall be white, reflectorized. The paint for taxiways, taxilanes and aprons shall be yellow, reflectorized. The paint for reflectorized aircraft containment lines shall be 340 GH "Fruity Fuchsia" traffic paint as manufactured by Somay Products, Inc., or equal and meeting the requirements of Federal Specifications TT-P-1952. "Fruity Fuchsia" paint, surplus to the project, shall be delivered to the Dade County Aviation Department.

e. Thermoplastic Traffic Paint. Thermoplastic traffic striping paint shall meet the requirements of Section 711 ""Thermoplastic Traffic Stripes and Markings" of the current edition of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The painted stripes shall be reflectorized.

f. The paint shall be lead free and solvent free (solvent free means that the paint's VOC content is less than 150 grams per liter).

g. The manufacturer of a paint supplied under this Section shall certify that the paint system meets the above specified specifications, as applicable; in addition, the manufacturer of the paint shall furnish certified laboratory test results of the composition of the furnished paint and Material Safety Data Sheet (MSDS).

620-2.2 REFLECTIVE MEDIA. Glass spheres shall meet the requirements of Fed. Spec. TT-B-1325, Type III, gradation A.

620-2.3 TEMPORARY MARKING TAPES. The tape for temporary marking and striping shall be removable pressure sensitive reinforced plastic film (suitable for application without a primer) 6" wide reflectorized pavement striping tape as manufactured by the 3M Company, under the "SCOTCHLANE" Brand name or approved equal. The tape shall meet the requirements of Subsection 102-3.3.2.3 of the 1991 Florida DOT Standard Specifications for Road and Bridge Construction and must be on the current list of approved traffic tapes maintained by the FDOT on file with the office of Value Engineering at Tallahassee. Colors shall be equal to 3M colors 5710 "White" and 5711 "Yellow".

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. The painting shall be performed only when the surface is dry, when the atmospheric temperature is above 45° F *(7° C)*, and when the weather is not excessively windy, dusty or foggy.

620-3.2 EQUIPMENT. All equipment for the work shall be approved by the Architect/Engineer and shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall be designed so as to apply markings of uniform cross sections and clear-cut edges without running or spattering and within the limits for straightness set forth herein. When needed, a dispenser shall be furnished which is properly designed for attachment to the mechanical marker and suitable for dispensing the required quantity of reflective media.

Suitable adjustments shall be provided on the sprayer(s) of a single machine or by furnishing additional equipment for painting the width required.

620-3.2.1 TAPE APPLICATION EQUIPMENT. The Contractor may, for the application of the temporary tape marking and stripping, use the following 3M Company equipment, furnished on a loan basis by the Dade County Aviation Department for the project:

SLT-180 - Roll Striper complete with 6" dispensing head
SLT-180-10 - Roll Striper Tamper
SLT-180-50 - Roll Striper Cut Off Device

At the completion of the project, the Contractor shall return all of the above equipment, in good working order, to the Dade County Aviation Department. The Contractor shall also deliver striping tape surplus to the project to the Dade County Aviation Department.

Equipment for the application of the Thermoplastic Traffic Paint shall be in accordance with the requirements of Section 711 "Thermoplastic Traffic Stripes and Markings" of the current edition of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

620-3.3 PREPARATION OF SURFACE. Immediately before application of the paint or tape, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material which would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials and all other undesirable materials prescribed above.

Asphalt areas which cannot be satisfactorily cleaned by brooming and blowing shall be scrubbed as directed with a water solution of trisodium phosphate (10% Na_3Po_4 by weight) or an approved equal solution. After scrubbing, the solution shall be thoroughly rinsed off and the surface dried prior to painting.

Paint shall not be applied to new portland cement concrete pavement until the concrete in the areas to be painted is cured and is clean of curing material. Sand blasting or high pressure water shall be used to remove curing material or any other deleterious deposits from concrete surfaces.

Existing marking and striping that is to be abandoned and removed shall be done by the best method suited for the purpose, such as sand or water blasting using approved procedures and equipment. Painting out marking or striping with neutral color paint is not an acceptable method of permanently removing existing paint.

620-3.4 LAYOUT OF MARKINGS. On those sections of pavement where no previously applied markings are available to serve as a guide, the proposed markings shall be laid out in advance of the paint application. Control points shall be spaced at such intervals as will insure accurate location of all markings.

The Contractor shall provide a Florida licensed land surveyor to supervise the location, alignment, layout, and dimensions of the applied stripings and markings.

620-3.5 APPLICATION. Markings shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface have been approved by the Architect/Engineer.

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate of 100 to 110 square feet per gallon *(2.45 to 2.7 square meter per liter)*. The addition of thinner will not be permitted. Except as prescribed below or directed by the Architect/Engineer, a period of not less than 24 hours shall elapse between placement of a bituminous surface course or seal coat and application of the rubber and water emulsion base paints. Other paints shall be applied as directed by the paint manufacturer and as approved by the Architect/ Engineer; however, it shall not be applied prior to the expiration of not less than 24 hours after the placement of asphaltic concrete pavement. The paint shall not bleed excessively, curl, or discolor when applied to bituminous surfaces.

A period of not less than 30 days shall lapse between placement of a bituminous surface course and application of the thermoplastic striping paint. The

thermoplastic paint shall be applied at an average film thickness of 0.060 inch *(1.5 mm)*.
Preparation and application of the thermoplastic striping paint shall be in accordance with the requirements of Section 711 "Thermoplastic Traffic Stripes and Markings" of the current edition of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

Surface preparation and the application of the Polyurethane or Epoxy-Phenolic paints on PCC aprons shall be in strict accordance with the paint manufacturer's written instructions, subject to approval by the Architect/Engineer.

The edges of the markings shall not vary from a straight line more than 1/2 inch *(12.5 mm)* in 50 feet *(16.4 meters)*, and the dimensions shall be within a tolerance of plus or minus 5 percent. When reflectorized painting is specified, the glass spheres shall be distributed to and imbedded into the surface of the marked areas immediately after application of the paint. A dispenser shall be furnished which is properly designed for attachment to the marking machine and suitable for dispensing glass spheres. The spheres shall be applied at the rate of 10 pounds per gallon *(0.12 kg per liter)* of paint, except that when applied with thermoplastic paint the glass spheres shall be applied at the rate of one (1) pound per ten (10) square feet *(0.5 kg per square meter)* of painted area. Glass spheres shall not be applied with temporary pavement painting and between layers of bituminous pavement overlays.

The contractor shall furnish certified test reports for the materials shipped to the project. The reports shall not be interpreted as a basis for final acceptance. The contractor shall notify the Architect/Engineer upon arrival of a shipment of paint to the job site. All emptied containers shall be returned to the paint storage area for checking by the Architect/Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Architect/Engineer.

All temporary marking tape shall be applied as and where shown on the Plans, the specifications, or as directed by the Architect/Engineer, in strict accordance with the manufacturers written instructions, subject to approval by the Architect/Engineer.

620-3.6 PROTECTION. After application of the paint, all markings shall be protected from damage until the paint is dry. All surfaces shall be protected from disfiguration by spatter, splashes, spillage, or drippings of paint.

The Contractor shall be directly responsible and shall erect or place suitable warning signs, flags or barricades, protective screens, or coverings as required to protect all surfaces and the public.

620-3.7 DEFECTIVE WORKMANSHIP OR MATERIAL. When any material not conforming to the requirements of the Specifications or Plans has been delivered to the project or incorporated in the work or any work performed is of inferior quality, such material or work shall be considered defective and shall be removed or otherwise corrected as directed by the Architect/Engineer, at the expense of the Contractor.

METHOD OF MEASUREMENT

620-4.1 Measurement of Pavement Painting for payment shall be the number of square (feet) *(meter)* of painting of the various colors or types, or linear (feet) *(meters)* of striping tape, as shown on the Plans, completed and accepted in accordance with the Plans and these Specifications.

The quantity of striping tape to be delivered by the Contractor to the job-site must be approved by the Architect/Engineer prior to placing any purchase order. The quantity of surplus striping tape shall be measured by the roll, at the end of the project.

The quantity of surplus "Fruity Fuchsia" paint turned over to DCAD shall be measured by the (gallon) *(liters)*, at the end of the project.

Measurement of Removal of Existing markings for payment shall be the number of square (feet) *(meters)* removed, as shown on the Plans or as directed by the Architect/ Engineer, and completed in accordance with the Specifications.

BASIS OF PAYMENT

620-5.1 Payment for the quantities measured as described above shall be made at the Contract Unit Price Bid, per Square (Foot) *(Meter)* for Pavement Painting, per Square (Foot) *(Meter)* for Thermoplastic Traffic Paint, per Square (Foot) *(Meter)* for Temporary Painting, per Linear (Foot) *(Meter)* for Striping Tape, and per Square (Foot) *(Meter)* for Removal of Existing markings, which prices and payment shall be full compensation for furnishing all labor, materials, equipment, processes, tools, and incidentals necessary to complete the work covered under this Section. Payment for surplus Striping Tape and "Fruity Fuchsia" paint will be made based on the purchase order invoice cost. The unit price bid for the item Striping Tape shall also include the cost of the removal of the tape.

Payment will be made under:

Item No.	Pavement Painting (______, ______) color type	Per Square (Foot) *(Meter)*
Item No.	Thermoplastic Traffic Paint	Per Square (Foot) *(Meter)*
Item No.	Temporary Painting	Per Square (Foot) *(Meter)*
Item No.	Striping Tape (6") *(15 cm)*	Per Linear (Foot) *(Meter)*
Item No.	Removal of Existing Markings	Per Square (Foot) *(Meter)*

TESTING AND MATERIAL

Test and Short Title	Material and Short Title
None	1/TT-P-1952B - Paint Traffic and Airfield marking, water emulsion base
	1/TT-B-1325 - Beads (Glass Spheres); Retro-reflective
	2/MIL-C-83286 - 2 Part Polyurethane Paint

2/MIL-C-46168 - 2 Part Polyurethane Paint
2/MIL-C-81733 - 2 Part Polyurethane Paint
3/FDOT Std. Specifications Section 102 - Maintenance of Traffic - Tapes
3/FDOT Std. Specifications Section 711 - Thermoplastic Traffic Stripes and Markings

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1/Federal Specification

2/Military Specification

3/Florida DOT Standard Specifications for Road and Bridge Construction, current edition

END OF SECTION

Item P-621 Saw-Cut Grooves

DESCRIPTION

621-1.1 This item consists of constructing saw-cut grooves to minimize hydroplaning during wet weather, providing a skid resistant surface in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR).

The work shall be accomplished by a qualified grooving subcontractor approved by the Engineer. The proposed subcontractor shall have at least three (3) years' experience demonstrating a level of quality in grooving operations similar or better to the requirements of this project. The Contractor shall furnish the Engineer, for his approval, sufficient information concerning the subcontractor's qualifications and experience.

The Contractor shall also furnish the Engineer with a detailed list of equipment and explain the procedures and methods to be used in the grooving operation. The Engineer's decision to approve or disapprove any grooving subcontractor shall be final.

CONSTRUCTION METHODS

621-2.1 Procedures. The Contractor shall submit to the ENGINEER the grooving sequence and method of placing guide lines to control grooving operation. Transverse grooves saw-cut in the pavement must form a 1/4 inch (+1/16 inch, -0 inch) wide by 1/4 inch (±1/16 inch) deep by 1-1/2 inch (-1/8 inch, +0 inch) center-to-center configuration. The grooves must be continuous for the entire runway length and designated length of taxiway. They must be saw-cut transversely (perpendicular to centerline) in the runway and high-speed taxiway pavement to not less than 10 feet from the runway or taxiway pavement edge to allow adequate space for equipment operation.

The saw-cut grooves must meet the following tolerances. The tolerances apply to each day's production and to each piece of grooving equipment used for production. The Contractor is responsible for all controls and process adjustments necessary to meet these tolerances. The Contractor shall routinely spot check for compliance each time the equipment aligns for a grooving pass.

a. Alignment tolerance. The grooves shall not vary more than ±1-1/2 inch (38 mm) in alignment for 75 feet (23 m) along the runway length, allowing for realignment every 500 feet (150 m) along the runway length. Suitable layouts and lines of proposed grooving shall be accomplished in advance of the grooving operation. Control points shall be spaced at such intervals as will ensure accurate location of the grooves.

b. Groove tolerance.

(1) Depth. The standard depth is 1/4 inch (6 mm). At least 90% of the grooves must be at least 3/16 inch (5 mm), at least 60% of the grooves must be at least 1/4 inch (6 mm), and not more than 10% of the grooves may exceed 5/16 inch (8 mm).

(2) Width. The standard width is 1/4 inch (6 mm). At least 90% of the grooves must be at least 3/16 inch (5 mm), at least 60% of the grooves must be at least 1/4 inch (6 mm), and not more than 10% of the grooves may exceed 5/16 inch (8 mm).

(3) Center-to-center spacing. The standard spacing is 1-1/2 inch (38 mm). Minimum spacing 1-3/8 inch (34 mm). Maximum spacing 1-1/2 inch (38 mm).

Saw-cut grooves must not be closer than 3 inches (8 cm) or more than 9 inches (23 cm) from transverse joints in concrete pavements. Grooves must not be closer than 6 inches (150 mm) and no more than 18 inches (0.5 m) from in-pavement light fixtures. Grooves may be continued through longitudinal construction joints. Where neoprene compression seals have been installed and the compression seals are recessed sufficiently to prevent damage from the grooving operation, grooves may be continued through the longitudinal joints. Where neoprene compression seals have been installed and the compression seals are not recessed sufficiently to prevent damage from the grooving operation, grooves must not be closer than 3 inches (8 cm) or more than 5 inches (125 mm) from the longitudinal joints. Where lighting cables are installed, grooving through longitudinal or diagonal saw kerfs shall not be allowed.

The Contractor must submit a written daily report to the Engineer indicating how often the grooving subcontractor adjusted production, including blade replacement.

At the Engineer's discretion, more testing than the minimum of three per day per grooving machine in response to the level of surface variability.

621-2.2 Environmental requirements. Grooving operations will not be permitted when freezing conditions prevent the immediate removal of debris and/or drainage of water from the grooved area. Discharge and disposal of waste slurry shall be the Contractor’s responsibility.

621-2.3 Control strip. Groove a control strip in an area of the pavement outside of the trafficked area, as approved by the ENGINEER. The area shall be **75** feet minimal long by two lanes wide. Demonstrate the setup and alignment process, the grooving operation, and the waste slurry disposal.

621-2.4 Existing pavements. Not Used

621-2.5 New pavements. New asphalt pavements shall be allowed to cure for a minimum of 30 days before grooving, to allow the material to become stable enough to prevent closing of the grooves under normal use. If it can be demonstrated that grooves are stable, and can be installed with no spalling, tearing or raveling of the groove edge, grooving may occur sooner that 30 days with approval of the ENGINEER. All grade corrections must be completed prior to grooving. Spalling along or tearing or raveling of the groove edges shall not be allowed.

621-2.6 Grooving machine. Provide a grooving machine that is power driven, self-propelled, specifically designed and manufactured for pavement grooving, and has a self-contained and integrated continuous slurry vacuum system as the primary method for removing waste slurry. The grooving machine shall be equipped with diamond-saw cutting blades, and capable of making at least 18 inches (0.5 m) in width of multiple parallel grooves in one pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. Match the blade type and configuration with the hardness of the existing airfield pavement. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. Provide the machine with devices to control depth of groove and alignment. The grooving machine must be provided with devices to control alignment. Flailing type grooving will not be permitted**.**

621-2.7 Water supply. Water for the grooving operation shall be provided by the Contractor. The Contractor shall make the necessary arrangements with the Owner of the water source for securing and transporting such water. No separate payment will be made for water used, but the cost thereof shall be included in the various items of the proposal and bid schedule.

621-2.8 Clean-up. During and after installation of saw-cut grooves, the Contractor must remove from the pavement all debris, waste, and by-products generated by the operations to the satisfaction of the ENGINEER. Cleanup of waste material must be continuous during the grooving operation. Flush debris produced by the machine to the edge of the grooved area or pick it up as it forms. The dust coating remaining shall be picked up. Accomplish all flushing operations in a manner to prevent erosion on the shoulders or damage to vegetation. Waste material must be disposed of in an approved manner. Waste material must not be allowed to enter the airport storm sewer system. The Contractor must dispose of these wastes off-airport property in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

The Contractor shall utilize a vacuum truck to continuously vacuum up all waste material and slurry during the grooving operations. The Contractor shall also maintain a bulk tanker on site to transfer the vacuumed materials into prior to disposal. The Contractor shall not, under any circumstances, deposit the waste materials or slurry generated by the grooving operations on the pavement or surrounding sod or grass areas. All waste material and slurry shall be contained in either the vacuum truck or bulk tanker.

The Contractor shall thoroughly wash all grooves to ensure all grooves are clean and free to transfer runoff from the pavement without obstruction during grooving operations.

621-2.9 Repair of damaged pavement. Grooving must be stopped and damaged pavement repaired at the Contractor's expense when directed by the ENGINEER.

621-2.10 Production rate. The Contractor must furnish sufficient equipment to groove **70,000** square yards of pavement per week.

ACCEPTANCE

621-3.1 Acceptance testing. Grooves will be accepted based on results of zone testing. All acceptance testing necessary to determine conformance with the groove tolerances specified will be performed by the ENGINEER.

Instruments for measuring groove width and depth must have a range of at least 0.5 inch (12 mm) and a resolution of at least 0.005 inch (0.13 mm). Gauge blocks or gauges machined to standard grooves width, depth, and spacing may be used.

Instruments for measuring center-to-center spacing must have a range of at least 3 inches (8 cm) and a resolution of at least 0.02 inch (0.5 mm).

The ENGINEER will measure grooves in five zones across the pavement width. Measurements will be made at least three times during each day's production. Measurements in all zones will be made for each cutting head on each piece of grooving equipment used for each day's production.

The five zones are as follows:

Zone 1	Centerline to 5 feet (1.5 m) left or right of the centerline.
Zone 2	5 feet (1.5 m) to 25 feet (7.5 m) left of the centerline.
Zone 3	5 feet (1.5 m) 25 feet (7.5 m) right of the centerline.
Zone 4	25 feet (7.5 m) to edge of grooving left of the centerline.
Zone 5	25 feet (7.5 m) to edge of grooving right of the centerline.

At a random location within each zone, five consecutive grooves sawed by each cutting head on each piece of grooving equipment will be measured for width, depth, and spacing. The five consecutive measurements must be located about the middle blade of each cutting head ±4 inches (100 mm). Measurements will be made along a line perpendicular to the grooves.

- Width or depth measurements less than 0.170 inch (4 mm) shall be considered less than 3/16 inch (5 mm).

- Width or depth measurements more than 0.330 inch (8 mm) shall be considered more than 5/16 inch (8 mm).
- Width or depth measurements more than 0.235 inch (6 mm) shall be considered more than 1/4 inch (6 mm).

Production must be adjusted when more than one groove on a cutting head fails to meet the standard depth, width, or spacing in more than one zone.

METHOD OF MEASUREMENT

621-4.1 The quantity of grooving to be paid for shall be the number of square yards of grooving performed in accordance with the specifications and accepted by the ENGINEER per paragraph 621-3.1.

BASIS OF PAYMENT

621-5.1 Payment for saw-cut grooving. Payment for saw-cut grooving will be made at the contract unit price per square yard for saw-cut grooving. This price shall be full compensation for furnishing all materials, and for all preparation, delivering, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-621-5.1	Runway and Taxiway Grooving per square yard

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF ITEM P-621

SECTION P-701
TRENCHING, BACKFILLING AND JACKING

DESCRIPTION

701-1 The work to be performed under this Section consists of the excavation, dewatering, backfilling, jacking and boring, and incidentals common to the work under the various Sections of work under the Contract and as shown on the Plans.

The provisions of this Section P-701 shall apply to and govern the trenching and excavation work of all water supply, sanitary sewer (gravity and force mains), storm drainage, chilled water piping, industrial wastewater piping, underground airport fueling systems and airport lighting installations specified under the various Sections of work under the Contract.

MATERIALS

701-2.1 BACKFILL MATERIAL. Backfill material shall be selected granular material obtained from excavation or approved borrow sources. Trench backfill material placed from 6 inches *(15 cm)* below the bottom of the pipe to one (1) foot *(30 cm)* over the top of the pipe shall be material which can be readily compacted by mechanical and/or hydraulic methods. It shall, except for externally coated pipes, not contain stones retained on a 2-inch *(50 mm)* sieve, lumps or chunks of highly plastic soil or any other unsuitable material. For externally coated pipes, it shall be approved silica sand, limerock screenings or approved bedding materials as specified in the applicable specifications. The material shall be moistened or dried, if necessary, to be compacted by the method in use. Backfill shall be approved by the Architect/Engineer.

701-2.2 CONCRETE AND STEEL REINFORCEMENT. Concrete for encasing pipes, pipe cradles, thrust blocks and other miscellaneous concrete work shall, unless otherwise specified or shown on the Plans, be concrete class I and steel reinforcement grade 60 *(Grade 400)*, meeting the requirements of DCAD Standard Technical Specification Section P-610.

701-2.3 PAVING MATERIAL. Paving material for use in restoration of pavement when pipe trenches are excavated within paved areas shall conform to the details shown on the Plans or as ordered by the Architect/Engineer and to the applicable requirements of DCAD Standard Technical Specification Sections P-152, P-154, P-211, P-401, P-501, P-602, P-603, P-605 and P-609, as applicable.

CONSTRUCTION METHODS

701-3.1 EXCAVATION. The Contractor shall perform all trenching and excavation for the proper installation of the proposed work in accordance with the applicable requirements of DCAD Standard Technical Specification Sections D-701, D-751 and D-752.

Trenches for pipe line installations shall be sized to provide a clearance on each side of the pipe of not less than eight 8 inches *(20 cm)*. The depth of excavation shall be as shown on the Plans. The bottom of trenches shall be shaped so that the lower one-third of the installed pipe is uniformly and continuously supported throughout its length. Trenches shall be shaped to provide clearance for joint construction and to eliminate contact beneath pipe couplings.

Where intermittent or continuous rock formations are encountered in trench bottoms, excavation shall be carried to a depth of 6 inches *(150 mm)* below the level of the pipe barrel.

Excavation for thrust blocks shall provide a firm, undisturbed, vertical trench wall for thrust block bearing.

Excavation for structures shall be sufficient for the proper installation and construction of the proposed work in accordance with the elevations and dimensions shown on the Plans. Adequate clearance and working space shall be provided between the outer surfaces of structures and the embankment, or bulkheads, sheeting or shoring used to support the embankment.

701-3.2 SUPPORT OF EXCAVATION. The Contractor shall install all bracing, sheathing or sheathing necessary to implement and protect the excavation and the structure as required for safety in conformance with OSHA and Florida Trench Act Provisions and the applicable safety requirements of the Contract Documents.

Unless otherwise directed or approved in writing by the Architect/ Engineer, bracing, sheathing, or shoring involved in the construction of this work shall be removed by the Contractor after the completion and testing of the structure or pipeline, or other utility, as applicable. Bracing, sheathing, shoring and support of excavation shall not, under any circumstances, be permitted to remain under paved areas. Removal shall be effected in a manner which will not impair the integrity of the trench, or the safety of the workers and which will not disturb the backfill or mar finished masonry, or damage adjacent existing construction, the installed pipeline, or the underground utility or protective coatings.

Support of excavations system shall be designed, signed and sealed by a Florida registered professional engineer employed and paid for by the Contractor. The Contractor shall be responsible for the construction of the support of excavation system in strict accordance with the approved support of excavation system.

701-3.3 DEWATERING. Unless otherwise specified or shown on the Plans, dewatering of excavations for work performed at the Miami International Airport will not be permitted. All underwater construction shall be performed in accordance with the applicable requirements of DCAD Standard Specifications Section P-710.

When specifically required for connections to existing mains to be performed in the dry, the Contractor shall dewater trenches and other excavations as necessary for the satisfactory completion of the work. No dewatering shall be performed until after securing the appropriate dewatering permits as specified in Section 01561 of Division 1.

Where dewatering is permitted or specified, the Contractor shall provide all necessary pumps, underdrains, well point systems, and other means for removing water from excavations. Dewatering operations shall continue until backfilling has progressed sufficiently to prevent flotation or movement of the work. Water from the trenches and other excavations shall be disposed of in accordance with the applicable requirements of DCAD Standard Specifications Section P-160 and as directed by the Architect/Engineer.

701-3.4 BACKFILL. The Contractor shall backfill all excavations in accordance with the applicable provisions of the technical specifications and the DCAD Standard Technical Specification Sections P-152, D-701, D-751 and D-752 and the following requirements.

Backfill shall be placed in layers compacted to the specified density. Vibratory method of compacting backfill may be employed at the Contractors option.

Excavation below the levels specified shall be backfilled and compacted as specified for backfill above pipe, except when below water table.

Trench excavated below the level of the bottom of the pipe barrel shall, when so directed by the Architect/Engineer, be backfilled with specified select backfill material to the level of the lower one-third of the pipe barrel, compacted to not less than 96% percent of maximum density, and shaped, smoothed, and leveled to receive the pipe.

After installation of the pipe, and preliminary inspection by the Architect/Engineer, the trench shall be backfilled in 6 inch *(150 mm)* layers, and compacted to not less than 98% of maximum density up to 12 inches *(30 cm)* above the top of the pipe, except that the joints shall remain fully exposed until after the pipe has been pressure tested and accepted by the Architect/Engineer.

After the work has been tested, inspected and accepted by the Architect/Engineer, the remainder of the trench, up to the underside of pavement section or the top of subgrade shall be backfilled using select backfill material placed in 8 inch *(20 mm)* layers and compacted to not less than 98% maximum density.

Any installed material displaced or damaged during backfilling shall be repaired or replaced.

Backfill of excavations for structures shall not begin until structures have been constructed, and all pipe connections made, inspected, and approved by the Architect/Engineer. Compacted density of backfill shall be as specified for backfill above pipe.

The Contractor may, at his option, backfill pipe trench using the hydraulic method of attaining compaction provided that the Contractor achieve all densities, specified elsewhere herein or shown on the Plans. Under this system of backfill, the first lift is carried to the spring line of pipe and the second lift to 6 inches *(150 mm)* above the top of the pipe. Each lift shall be flooded with water and compacted by vibration using a concrete vibrator while the soil is in a saturated condition. Succeeding lifts not over 18 inches *(45 cm)* in depth, may be similarly placed and compacted. Vibratory compaction shall not be employed above bottom of subgrade under pavements. Under this system, backfill materials must be granular materials meeting the requirements of P-701-2.1 except that it shall not contain stones or aggregate particles retained on a one-half inch *(12.5 mm)* sieve and shall be suitable for hydraulic compaction.

Backfill for work performed underwater, as required by Section P-710, shall be performed using the hydraulic backfilling method specified above.

701-3.5 ADDITIONAL EXCAVATION AND BACKFILL. Where organic material, roots, muck, or other material unsatisfactory for pipe foundation conditions is encountered at or below the bottom of excavation, it shall be removed and disposed of within the airport property, as directed by the Architect/Engineer. The resulting excavation shall be backfilled to a level six inches *(150 mm)* below the bottom of the proposed pipe barrel or structure with approved backfill material placed and compacted to not less than 96% of maximum density. The remaining six inches *(150 mm)* of the excavation shall be backfilled using selected backfill material, placed and compacted as specified for backfill around pipe.

Additional excavation shall be performed only when ordered by the Architect/Engineer.

701-3.6 COMPACTION AND DENSITIES. Control and testing of backfill construction work under this Section shall be performed in accordance with the requirements of DCAD Standard Technical Specification Section T-611 "DCAD Compaction Control Tests" and as noted on the Plans.

701-3.7 JACKING PIPES. Where shown on the plans, the Contractor shall install pipes under existing pavement or railroad tracks by jacking methods. Pipes shall be jacked in place between the limits shown on the Plans, specified or as ordered by the Architect/Engineer.

The strength of pipe designated in the Contract Documents is established to support vertical loads only. Additional reinforcement or strength of pipe (if any) as required to withstand jacking pressures, shall be determined and furnished by the Contractor.

Variation from theoretical alignment and grade at the time of completion of jacking placement shall not exceed one percent (1%) of the distance from the jacking point.

An approach trench shall be constructed on the side from which jacking operations shall take place. The end of the approach trench away from the jacking face shall be cut perpendicular to the axis of the jacking operation to provide bearing surface for the back stop and the jack blocking. The length of the approach trench shall be such that the distance between the jack blocking and the face of the bore shall be equal to five feet *(1.5 m)* plus the length of the individual pipe sections in the case of steel pipe, or equal to two lengths of pipe plus a minimum of 7 feet *(2.1 m)* in the case of concrete pipe. The jacking face shall be a minimum of 3 feet *(90 cm)* above the top of the pipe; the face shall be cut vertically and shall be shored to prevent ravelling and slipping. A sump shall be constructed in one corner of the trench to provide drainage. The back stop shall be constructed of heavy timbers or steel rails capable of withstanding the jacking forces.

In the event the site of jacking operations is such that an approach trench cannot be constructed, the jack blocking shall be constructed to carry the reaction of the jack to the ground. This may be accomplished by means of timber, steel, or concrete vertical back stops set into the ground with the tops supported by diagonal members bearing against an embedded anchorage.

Directly opposite the approach trench, an exit trench shall be constructed to line and grade. The exit trench shall be constructed in the same manner as the approach trench except that no back wall is necessary.

Jacks shall be of sufficient capacity to overcome soil resistance to the jacking operation and shall be operated in pairs. As a guide, capacity of jacks for concrete pipes shall be minimum of 50 tons *(45000 kgs)* each. For large pipes, more than one pair of jacks may be required. Small track jacks may be used to start the pipe.

Pipe guides shall be constructed in the approach trench and may be either timber or steel rail or concrete guide on a cradle. Since the pipe guides will support the pipe as it enters the jacking face, the pipe guides shall be accurately set to line and grade, and excavation for the guides shall be made to grade to avoid any settlement. Guides shall be spaced at distances not to exceed 0.4 of the outside diameter of the pipe.

Reaction of the jack to the pipe shall be transmitted by either a jacking frame or jacking beams constructed of timber or steel. Jacking frames and beams shall be so placed as to exert equal pressure on each side of the pipe. For pipes 36 inches *(90 cms)* in diameter or smaller, a steel jacking ring may be used in lieu of the jacking frame.

The pressure from the jacking frame or beams may be transmitted to a jacking collar or head on the pipe itself. Jacking collars or heads for concrete pipe shall be constructed to prevent damage to the pipe ends. Jacking collars and jacking frames shall be constructed to allow passage of men and material.

Steel cutting edges on the lead section of pipe may be used, and the use of a jacking shield is permitted.

To prevent the pipe from "freezing" and becoming incapable of movement, jacking operations should, if possible, be carried out on a 24-hour basis. A minimum of two 8-hour shifts shall be worked. Alignment and grade of the pipe guides shall be checked at least once each shift. To aid in the prevention of "freezing" the pipe may be lubricated in a manner and with a material meeting the approval of the Architect/Engineer.

Excavation for the bore shall be to grade at the bottom and approximately one inch *(25 mm)* greater than the diameter of the pipe at the top and sides. Sluicing or jetting with water will not be permitted. When material tends to cave in from outside these limits, a metal shield shall be used ahead of the first section of pipe or the face of excavation shall not extend beyond the end of pipe more than 18 inches *(45 cm)*, unless permitted by the Architect/Engineer.

Areas resulting from caving or excavating outside the above limits shall be backfilled with sand or mortar by a method approved by the Architect/Engineer which will fill the voids.

Initial jacking of concrete pipe shall begin with two sections of pipe in the trench. As excavation proceeds, the jacking shall proceed until the effective limit of the jacking is reached, at which time additional blocking shall be added. This process shall be continued until there is room for an additional pipe section.

Joints in concrete pipes shall be made using rubber gaskets meeting the requirements of DCAD Section D-701.

After the pipe has been jacked into place, the backfill shall be tightly compacted around both ends of the culvert to prevent erosion. Any departure from the above specifications necessitated by site conditions shall be subject to approval, in writing by Architect/Engineer.

The Contractor shall submit to the Architect/Engineer a complete plan and schedule for pipe installation procedure prior to the commencement of such work. The submission shall include complete details of the sheeting, shoring and bracing for the protection of the pavement or railroad tracks, and the materials and equipment pertinent to the jacking operation. The Contractor shall not proceed with the pipe installation until his proposed plan and schedule has been approved by the Architect/Engineer.

Construction shall be carried on in such a manner that settlement of the ground surface above the pipe line will not occur.

Joint sealant material for concrete pipes shall be placed ahead of the jacking frame. The Contractor shall replace or repair, as directed by the Architect/Engineer, pipe which is damaged during the jacking operations. Joints of steel pipe shall be butt welded, watertight, and the welding tested as installation progresses.

If the installation of the pipe is being conducted in an unsafe or improper manner, as determined by the Architect/Engineer, the Contractor will be required to stop the work and bulkhead the heading until an alternate procedure has been proposed and accepted.

MEASUREMENT AND PAYMENT

701-4.1 No direct measurement or payment will be made for work under this Section P-701, but the cost therefor shall be considered incidental to, and included in the unit prices of the various Contract items, as applicable.

END OF SECTION

SECTION T-611
DCAD COMPACTION CONTROL AND LIMEROCK TESTING

DESCRIPTION

611-1.1 This Specification Section shall govern the determination of the maximum density, percent compaction of soil materials for which a minimum percent compaction is specified, and carbonates and organic contents in limerock materials.

A. This Section covers the basic procedures to be followed in performing the test for the determination of the maximum density, field density, percent compaction, and carbonates and organic contents. In all cases density of soils and limerock materials shall be stated as the dry weight in pounds per cubic foot.

B. The nuclear Moisture/Density Instruments (Troxler) are specified for the Contractor's use in the performance of the in-place quality control field test procedures.

C. The Sand Cone Test Method shall be the only Quality Assurance acceptance test method.

D. Section T-611 is included in the Contract Documents for technical guidance only. There shall be no separate or direct measurement and payment for work performed under this Section.

E. Carbonates and organic contents in limerock material shall be determined in accordance with the requirements of FDOT Test Method FM5-514, appended to this Section of the Specifications.

611-1.2 RESPONSIBILITY. The Contractor shall be solely responsible for all work performed and quality control procedures performed under this Section.

The Architect/Engineer will be responsible to the County for all Quality Assurance (QA) requirements, including inspections, acceptance testing and all other duties of the Architect/Engineer described in the Technical Specifications. The Architect/Engineer will direct a County approved Professional Testing Laboratory (referred to herein as the Project Testing Laboratory) to perform certain of the duties assigned to the Architect/Engineer. The Contractor shall refer all matters requiring approval or technical decisions to the Architect/Engineer, except for those certain specific matters wherein the Architect/Engineer has designated the Project Testing Laboratory as the operating agent of the Architect/Engineer.

611-1.3 MAXIMUM DENSITY (PROCTOR).

Maximum density is defined as the maximum dry weight in pounds per cubic foot obtained when a material is mixed with different percentages of water and compacted in a standard manner. The percentages of water at which maximum density is obtained is termed the optimum moisture content.

A. The maximum density shall be determined by the Project Testing Laboratory utilizing one of the methods described below, whichever is applicable.

a. **<u>Where All of the Material Passes a No. 4 *(4.75 mm)* Sieve.</u>** Use AASHTO T-180 (and ASTM D1557), Method B for designated areas.

b. **<u>Where the Material Contains Particles Larger</u> Than a No. 4 *(4.75 mm)* Sieve.** Use AASHTO T-180 (and ASTM D1557), Method D for designated areas.

c. **<u>Where the Material Contains Particles Larger Than 3/4 Inch *(19 mm)*</u>.** Follow the replacement procedure given in the note #8 under Method C of AASHTO T-180 (and ASTM D1557).

d. Only the two alternate procedures utilizing "A 6 inch *(15 cm)* mold, Methods B or D" shall be used to determine the relationship between the moisture content and density of soils, subbases or base courses (Proctor) under this Test Section.

e. Cement-treated soil samples shall be prepared in accordance with ASTM D558 except that the samples shall be fan-dried (not oven dried), and shall be completed and tested within one (1) hour.

B. The routine soil, cement-treated soil and limerock "Proctor" tests shall be performed in conformance with the following procedures:

a. No material shall be re-used and a new separate batch shall be prepared for each compaction or density test specimen (point).

b. Separate samples shall be prepared in 2% moisture increments so as to bracket the optimum moisture content of the soil sample.

c. The samples of soil-water mixtures shall be placed in airtight containers and allowed to cure for not less than 12 hours. (Soil-limerock samples may require 24-hour cure). Note: the water content should be redetermined if appreciable condensation occurs on the container wall.

611-1.4 - FIELD DENSITY.

Field density refers to the dry density expressed in pounds per cubic foot of a layer of compacted material in place at the site as determined by a proctor sample representative of the compacted layer. The field density shall be determined in accordance with current AASHTO and ASTM Test Procedures as referenced in Article 2.1.

611-1.5 - PERCENT COMPACTION.

The percent compaction is defined as the density of the compacted layer expressed as a percentage of the maximum density of the material when tested in accordance with these specifications.

611-1.6 - COMPUTATION.

The percentage of compaction is computed by the formula:

$$\text{Percent compaction} = (\text{Field Density} \div \text{Maximum Density}) \times 100$$

TESTING REQUIREMENTS

611-2.1 - FIELD DENSITY

A. Contractor's Quality Control Testing:

Compaction Quality Control Field Density Testing shall be performed by the Contractor using the Nuclear Moisture/Density Instrument (Troxler) following current AASHTO/ASTM standardized testing procedures. These tests are for the Contractor's guidance only, to ascertain when Maximum Density has been achieved and the area is ready for acceptance testing.

AASHTO T-238 or ASTM D-2922 - Nuclear Density
(for Contractor's use)

AASHTO T-239 or ASTM D-3017 - Nuclear Moisture
(for Contractor's use)

B. County's Acceptance Testing:

The Sand Cone Test Method shall be used as the only acceptance Quality Assurance test procedure.

The County's standard method of determining field density and acceptance testing is as follows:

The Project Testing Laboratory shall, whenever directed by the Architect/Engineer, prepare a one point proctor sample in accordance with AASHTO T-180 (and ASTM D1557) for each soil field density test, utilizing material adjacent to the density test area. He shall then compare the one point proctor to the moisture-density curve utilized to obtain the percentage compaction for verification that he used the correct curve. In aggregate materials, the same procedure shall be used, except that the frequency shall be modified to include the first field density test in each material and each tenth field density test thereafter, providing satisfactory results are obtained.

a. Field Density - Soils, Stabilized Subgrade, Subbases and Base Courses:

Test and Short Title:

AASHTO T-191 or ASTM D-1556 - Density of Soil in Place --Sand Cone Method

C. DCAD Standard Technical Specification P-701 - Hydraulic method for backfill and compaction of trenches and underground structures.

611-2.2 - CALIFORNIA BEARING RATIO

The CBR test shall be used for evaluating and measuring pavement subgrade layer soil strength. The tests for laboratory, remolded or undisturbed specimens, and on site field soil materials or limerock stabilized soil materials are as follows:

a. Laboratory CBR Test. Laboratory CBR tests shall be performed essentially in accordance with ASTM D-1883, Bearing Ratio of Laboratory Compacted Soils as given in Chapter VIII of Manual Series No. 10 (MS-10), latest edition, by the Asphalt Institute.

b. Field CBR Test. Field CBR tests shall be conducted in strict accordance with the procedure given in Chapter VIII of Manual Series No. 10 (MS-10) 2nd Edition, dated 1963, by the Asphalt Institute.

611-2.3 - ATTERBURG LIMITS

These routine ASTM soil tests shall be performed in accordance with the requirements of ASTM D 4318 (AASHTO-T-90), with the following U.S. Corps of Engineers modifications to the Standard Methods of test:

a. The sample shall not be oven-dried, nor subjected to any artificial drying before processing for testing.

b. The sample shall be soaked in water for 24 hours prior to washing.

c. The sample shall be washed through the No. 40 *(4.25 mm)* sieve. Material retained on the sieve shall be dried, then dry-sieved through the No. 40 *(4.25 mm)* sieve. The portion dry-sieved through the No. 40 *(4.25 mm)* sieve shall be combined with the material washed through the sieve. This combination shall be used for the liquid limit and plastic limit tests.

d. The sample shall be set aside and the water decanted or wicked off. No chemicals shall be added to hasten settlement of the fines. The sample shall be dried to approximately the liquid limit with care being taken to prevent caking or lumping during the drying process. The liquid limit test shall be performed from wet of the liquid limit to dry of the liquid limit, using the mechanical method. No dry soil shall ever be added to the sample during performance of either the liquid limit or the plastic test.

e. Water content shall be further reduced by air drying and the plastic limit performed. Drying shall not proceed below the plastic limit. Care shall be taken to prevent caking or lumping during drying.

f. The plastic limit test shall be performed on a ground glass plate.

g. Modifications to the soaking time and to the method of hastening settlement of the fines may be made when check tests of the specification material show that the modifications do not affect results.

END OF SECTION

Appendix I: FDOT Test Method FM 5-514 (Pages T-611-6 thru T-611-11).

APPENDIX I
TO
SECTION T-611
Florida Test Method
for

CARBONATES AND ORGANIC MATTER IN LIMEROCK

Designation: FM 5-514

1. SCOPE

1.1 This method covers the chemical analysis of limerock for carbonates of calcium and magnesium and organic matter such as wood trash or other vegetation.

2. OUTLINE OF METHOD

2.1 Impurities are determined as acid insoluble matter and as the ammonium hydroxide precipitate; carbonates are then calculated by difference. Organic matter is determined as the loss on ashing of acid insoluble matter.

3. APPARATUS

3.1 Bunsen burners with tripods or suitable hot plates.

3.2 Balance, analytical,sensitive to 0.0001 gm complying with AASHTO M231, Class A, Types I or II.

3.3 Beakers, 300 ml or other convenient size.

3.4 Burettes, dispensing, 50.00 ml capacity.

3.5 Crucibles, porcelain, 15 ml nominal capacity.

3.6 Desiccator with drierite or other efficient desiccant.

3.7 Drying oven, gravity, capable of maintaining a temperature of 105° - 115°C. (221 - 239°F)

3.8 Filter funnels, glass, 60° nominal, 75mm nominal top diameter.

3.9 Gooch crucibles, 25 ml nominal capacity.

3.10 Jaw crusher and grinder capable of reducing dried samples to -- 90% passing the No. 40 sieve and with 100% passing the No. 10 sieve. Manual crushing of samples may be substituted for mechanical jaw crushers provided the integrity of the sample is maintained.

3.11 Muffle furnace capable of maintaining temperatures of 600 $\pm$ 50°C (1030° to 1200°F) and 900° $\pm$ 50°C (1550° to 1750°F).

3.12 Vacuum filter flask, one liter capacity.

3.13 Stirring rods and rubber policemen.

3.14 Wash bottles, polyethylene squeeze type.

4. REAGENTS AND SUPPLIES

4.1 Hydrochloric acid, * 1:5. Add 1 volume of reagent grade hydrochloric acid to 5 volumes distilled or deionized water and mix.

4.2 Ammonium hydroxide, * 1:5. Add 1 volume of reagent grade ammonium hydroxide to 5 volumes distilled or deionized water and mix.

4.3 Asbestos fiber, * Gooch grade, medium fiber length. Glass microfiber filter discs (2.1 cm) such as Whatman No. 934-AH may be used in lieu of asbestos.

4.4 Filter paper, Whatman No. 41, or equal, 12-1/2 cm. (Whatman No. 4 is an acceptable equal.)

4.5 Phenolphthalein Indicator. Dissolve 1 gram indicator grade phenolphthalein *in 100 ml reagent grade methanol* or denatured alcohol.*

Note: The concentrated acid and alkali should be handled under an efficient fume hood. The dilute (1:5) solutions may be used outside the hood without known harm. Avoid contact of all reagents with the skin and eyes. In the case of accidental splashes in the eyes, flush thoroughly with water and contact a physician. SEE SAFETY DATA SHEETS.

5. SAMPLE PREPARATION (Use FM 1-T248 where splitting or quartering is indicated).

5.1 Air dry gross sample.

5.2 Quarter to a convenient fraction for oven drying (at least 3 lb.).

5.3 Oven dry the split from 5.2 at 105°C (221°F) minimum for 12 hours minimum (overnight is convenient).

* See Safety Data Sheets

5.4 Crush the dried split to a size that will pass the pulverizer throat.

5.5 Pass the crushed material through a splitter until a split is obtained weighing at least 1/4 lb *(114 gm)*.

5.6 Pass this split through the pulverizer to obtain the final sample. Place this sample in a convenient container to await analysis.

5.7 Clean the pulverizer between samples to avoid contamination of the next sample.

6. METHOD

6.1 Give the sample a final mixing by stirring with a spatula.

6.2 Weigh 1 gram sample accurately and transfer to 300 ml beaker by brushing.

6.3 Add 20 ml of 1:5 hydrochloric acid to beaker slowly.

6.4 Bring to a momentary boil over a Bunsen flame or hot plate. Allow to stand until the last of the gas has evolved form the sample particles.

6.5 Filter through tared Gooch ignited crucible, transferring all solid material in the beaker to the Gooch by a combination of scrubbing and washing with water. Wash down walls and bottom of Gooch crucible twice with water. Save filtrate (see 6.8)

Note: A tared Gooch crucible is prepared by pouring a water suspension of asbestos fiber *into the crucible and sucking it down to a pad thick enough to trap the sample particles on the filtering set-up. the crucible is then heated in a muffle furnace at 950 $\pm$ 50^{o}C (1550 to 1750^{o}F) for 30 min., cooled in a desiccator and weighed.

6.6 Dry Gooch crucible for 2 hours at 105° - 115^{o}C (221°-239^{o}F), cool in desiccator to room temperature and weigh. Increase in weight represents insoluble silica, clay, and organic mater (Residue A).

6.7 Ignite Gooch crucible at 600° $\pm$ 50^{o}C (1112° $\pm$ 122^{o}F) for 30 minutes, cool to room temperature in desiccator, and reweigh. Loss in weight represents organic matter. (Loss B).

6.8 Transfer filtrate from Step 6.5 back to original beaker, neutralize to faint pink with phenolphthalein *(2 drops) using 1:5 ammonium hydroxide*. Bring solution to momentary boil, then allow to cool until precipitate has settled enough for rapid filtration. Filter through No. 41 paper, transferring all the precipitate to paper by washing with water. Wash paper five times, allowing paper to drain between washings.

* See Safety Data Sheets

6.9 Transfer drained paper and contents to a porcelain crucible, ash for 30 minutes at 900° $\pm$ 50°C (1650° $\pm$ 122°F). Cool crucible and contents in desiccator and weigh ash by transferring carefully to balance pan (Residue C).

6.10 Calculations:

% Carbonates of calcium and magnesium = (1.000 - Residues A and C) x 100

% Organic Matter = Loss B x 100

7. SHORT METHOD FOR CARBONATES ONLY

7.1 Place 1.000 g in 300 ml beaker.

7.2 Add 20 ml of 1:5 hydrochloric acid*.

7.3 Heat to boiling.

7.4 Allow to stand until the last of the gas has evolved from the sample.

7.5 Add 3 drops of phenolphthalein solution*.
7.6 Titrate to pink color with 1:5 ammonium hydroxide* and boil momentarily.

7.7 Filter and wash well with water.

7.8 Ignite in porcelain crucible at 900° $\pm$ 50°C (1650° $\pm$ 122°F) (or bright red) until all carbon is destroyed (30 minutes or longer).

7.9 Cool and weigh contents of crucible as insoluble residue (R).

7.10 The carbonate content is calculated as follows:

$$C = \frac{(W - R)}{W} \times 100$$

Where: C = percent of carbonates of calcium and magnesium
W = weight of sample
R = insoluble residue

8. PRECISION

8.1 Cooperative tests have shown that these differences between labs are reasonable:

<u>Carbonate Range</u>

90% and up $\pm$ 0.4%

* See Safety Data Sheets

50% - 75% $\pm$ 0.9%

9. SAFETY

9.1 Each hazardous material required in a procedure has been indicated by an asterisk indicating that the material safety data sheet should be consulted and cautions observed as indicated. Some judgement can be used. For example, dispensing 5 gallons of concentrated ammonium hydroxide from a 55 gallon carboy would indicate the need for a face shield; while dispensing eight droops from a one pound bottle would indicate that judgement could be used about the face shield as long as good ventilation was maintained.

Additionally, no employee is to use any of the hazardous reagents until thoroughly trained in the procedure and shown the proper use of devices such as hoods, ventilation fans, pipettes, etc.

Section 7 of ASTM Specification E-50 give additional helpful safety pointers. See Page 9 of FM 5-532.

* See Safety Data Sheets

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SECTION T-904
SODDING, SEEDING, AND FERTILIZING
SUPPLEMENT

The work to be performed under the classification of Sodding, Seeding, and Fertilizing shall meet the requirements of Section T-904 of the Miami Dade Aviation Department Standard Technical Specifications as supplemented, amended or modified herein.

DESCRIPTION

DELETE article 904-1.1 in its entirety and **INSERT**:

904-1.1 This item shall consist of furnishing, hauling, placing, and establishing live sod on prepared areas in accordance with the specification at the locations shown on the plans or as directed by the Architect-Engineer. Hydro-seeding shall not be used on this project.

CONSTRUCTION METHOD

ADD to article 904-3.5 the following paragraph:

904 3.5 LAYING SOD In the event that pegging does not adequately secure new sod from jet blast or propeller wash, the Contractor shall apply and secure wire mesh over the sodded area. Contactor shall remove all wire mesh prior to project completion at Architect-Engineer's direction.

BASIS OF PAYMENT

DELETE pay item under article 904-5.1 and INSERT:

Payment will be made under:

Item T-904-1 Sodding (SY), 4 Inches of Top Soil, Grade to Drain - per Square Yard (SY)

END OF SECTION

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T-904 SODDING, SEEDING AND FERTILIZING

DESCRIPTION

904-1.1 This item shall consist of furnishing, hauling, and placing approved live sod and seeding on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Architect-Engineer.

MATERIAL

904-2.1 SOD Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. all sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials which might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than 6 inches in height shall be mowed to height of 3 inches or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing abbove, shall be cut uniformly to a thickness not less than 2 inches.

Sod shall be a commercial grade of Pensacola Bahia.

904-2.2 FERTILIZER Fertilizer, as specified below, shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, water soluble potash, etc. They shall be applied at the rate and to the depth specified below, and shall meet the specified requirements of the applicable State and Federal laws.

They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated limme shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

c. A granular or pellet form suitable for application by blower equipment.

Fertilizer shall be rated 12-8-8 and shall be applied at the rate of 800 pounds per acre *(90 kgs per 1000 m^2)*. The mixture per short ton shall be as follows:

a.	6.5-15-0 (Base Goods)	1,065 Pounds *(483 kgs)*
b.	Muriate of Potash	267 Pounds *(121 kgs)*

c. Urea 380 Pounds *(172.4 kgs)*

d. Minor and Secondary Elements

1. Copper Oxide 16 Pounds *(7.26 kgs)*
2. Magnesium Sulfate 65 Pounds *(29.5 kgs)*
3. Zinc Sulfate 45 Pounds *(20.4 kgs)*
4. Borax 38 Pounds *(17.2 kgs)*
5. Chelated Iron 35 Pounds *(15.9 kgs)*
6. Manganese Sulfate 89 Pounds *(40.4 kgs)*

904-2.3 SEED Seed shall be applied uniformly and incorporated into the soil along with Fertilizer. Seed shall be applied at the following rate:

Bermuda (Common) -	20 Pounds per acre *(2.25 kgs per 1000 m^2)*
Pensacola Bahia -	60 Pounds per acre *(6.8 kgs per 1000 m^2)*
Japanese Millet -	20 Pounds per acre *(2.25 kgs per 1000 m^2)*

Seed shall conform to the requirements of Federal Specification JJJ-S-181. Seed shall be furnished separately or in mixtures in standard containers with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Architect/Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and the percentage of weed content for each kind of seed furnished and, in case of a mixture, the proportions of each kind of seed.

904-2.4 WATER The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the Architect-Engineer prior to use.

904-2.5 SOIL FOR REPAIRS Soil for repairs shall be taken from the surrounding affected area of from stockpiled strippings and shall be free of large stones, roots, stumps, or other deleterious materials that will interfere with subsequent sowing of seed, compacting and establishing turf, and shall be approved by the Architect-Engineer before being placed.

CONSTRUCTION METHODS

904-3.1 GENERAL Areas to be solid, strip, or spot sodded shall be shown on the plans. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition which are to remain undisturbed shall also be shown on the plans.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the Architect-Engineer before the various operations are started.

The Contractor shall demonstrate to the Architect-Engineer before starting the various operations that the application of required materials will be made at the specified rates.

904-3.2 PREPARING THE GROUND SURFACE After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 2 inches *(50 mm)* in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application off fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

904-3.3 APPLYING FERTILIZER AND SEED Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient and seed, as stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 2 inches *(50 mm)* by discing, raking, or other methods acceptable to the Architect-Engineer.

Any stones larger than 2 inches *(50 mm)* in any diameter, large clods, roots and other litter brought to the surface by this operation shall be removed.

904-3.4 OBTAINING AND DELIVERING SOD After inspection and approval of the source of sod by the Architect-Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 inches *(50 mm)*. Sod sections or strips shall be cut in uniform widths, not less than 10 inches *(25 cm)*, and in lengths of not less than 18 inches *(45 cm)*, but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded insde. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil the depth the sod is to be cut.

904-3.5 LAYING SOD Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the Architect-Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches *(10 cm)* immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately 1 inch *(25 mm)* below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On slopes steeper than 1 vertical to 2 1/2 horizontal and in V-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wooden pegs no less than 12 inches *(30 cm)* in length and have a cross-sectional area of not less then 3/4 square inch *(4.69 cm^2)*. The pegs shall be driven flush with the surface of the sod.

All sod shall be pegged as described in the final paragraph of this Article.

904-3.6 WATERING Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner which will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

904-3.7 ESTABLISHING TURF

a. General. The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work.

b. Protection. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the Architect-Engineer.

c. Mowing. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be mowed and the clippings raked and removed from the area.

d. Refertilizing. The period of establishment shall be two (2) months. Just prior to expiration of the establishment period, all sodded areas shall be refertilized.

Refertilization shall be applied at the rate of 400 Pounds per acre *(45 kgs per 1000 m^2)*, fertilizer shall be rated 15-0-0.

904-3.8 REPAIRING When the surface has become gullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the Architect-Engineer, and shall then be resodded as specified in 904-3.5.

METHOD OF MEASUREMENT

904-4.1 - This item shall be measured on the basis of the area in square (yards) *(meters)* of the surface covered with sod, seed and fertilized and accepted.

BASIS OF PAYMENT

904-5.1 Payment shall be made at the Contract Unit-Price Bid per Square (Yard) *(Meter)* for Sodding, Seeding and Fertilizing, which price and payment shall be full compensation for furnishing all materials, labor, equipment, processes, tools, and incidentals necessary to complete the work covered by this Section.

Item	Sodding	Per Square (Yard) *(Meter)*

TESTING AND MATERIAL REQUIREMENTS

Test and Short Title	Material and Short Title
JJJ - S - 181	Federal Specification

NOTE: Others as required by referenced specifications.

END OF SECTION

Item T-905 Topsoiling

DESCRIPTION

905-1.1 This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Engineer.

MATERIALS

905-2.1 Topsoil. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 in ~~(50 mm)~~ or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the association of official agricultural chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). The Engineer must approve the topsoil proposed by the Contractor. On-site or local topsoil material acceptable for proper growth of the specified sod (Bahiagrass) is acceptable when approved by the Engineer.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

905-2.2 Inspection and tests. Within 10 days following acceptance of the bid, the Engineer shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in 905-2.1.

CONSTRUCTION METHODS

905-3.1 General. Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Engineer before the various operations are started.

905-3.2 Preparing the ground surface. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Engineer, to a minimum depth of 2 in (~~50 mm~~) to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 in (50 mm) in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, ~~which have been established by others as shown on the plans~~, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

905-3.3 Obtaining topsoil. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the Engineer. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the Engineer. The topsoil shall be spread on areas already tilled and smooth-graded, or stockpiled in areas approved by the Engineer. Any topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoiling purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading,or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

905-3.4 Placing topsoil. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 2 in ~~(50 mm)~~ after compaction, unless otherwise shown on the plans ~~or stated in the special provisions~~. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (2 in (50 mm) or more in diameter), roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

~~METHOD OF MEASUREMENT~~

~~**905-4.1** Topsoil obtained on the site shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its original position and stripped or excavated. Topsoil stockpiled by others and removed for topsoiling by the Contractor shall be measured by the number of cubic yards (cubic meters) of topsoil measured in the stockpile. Topsoil shall be measured by volume in cubic yards (cubic meters) computed by the method of end areas.~~

~~**905-4.2** Topsoil obtained off the site shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its original position and stripped or excavated. Topsoil shall be measured by volume in cubic yards (meters) computed by the method of end areas.~~

~~BASIS OF PAYMENT~~

~~**905-5.1** Payment will be made at the contract unit price per cubic yard (cubic meter) for topsoiling obtained either from on site or off site. (obtained on the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~**905-5.2** Payment will be made at the contract unit price per cubic yard (cubic meter) for topsoiling (obtained off the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~Payment will be made under:~~

~~Item T-905-5.1~~	~~Topsoiling (Obtained on Site or Removed from Stockpile - per cubic yard (cubic meter)~~
~~Item T-905-5.2~~	~~Topsoiling (Furnished from off the site) – per cubic yard (cubic meter)~~

There will be no separate payment for topsoiling, as it is considered a subsidiary obligation to sodding.

TESTING MATERIALS

ASTM C 117	Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing

END OF ITEM T-905

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ITEM L-100 LIGHTING AND ELECTRICAL WORK

DESCRIPTION

100-1.1 GENERAL. The airfield electrical work to be done under this contract shall include the furnishing of all supervision, labor, materials, tools, equipment, and incidentals necessary to provide new airfield lighting and signing systems, and other electrical work as shown on the drawings.

Work shall be in accordance with Federal Aviation Administration Advisory Circular No. 150-5370-10G, Standards for Specifying Construction of Airports, as modified herein, other FAA Advisory Circulars and Specifications referred to herein, and other requirements as specified herein. All FAA Advisory Circulars shall be as specified, or the latest adopted edition if revised.

The electrical work shall comply with latest adopted editions, codes and standards applicable to this Contract as follows:

ANSI C2, National Electrical Safety Code
ASTM, American Society of Testing and Materials
FAA, Advisory Circulars
FAA, Orders
NEC, National Electrical Code (NFPA No. 70)
NECA, Standard for Installation
NEMA, Standard for Materials and Products
NFPA No. 101, Life Safety Code
UL, Underwriters Laboratories

All work shall be performed in strict accordance with these contract specifications, drawings, and any instructions that may be furnished by the Engineer during execution of the work to aid in interpretation of said drawings and specifications. Installation details and material and equipment specifications shall be in conformance with all applicable FAA advisory circulars. The contractor shall furnish written proof of FAA approval on all equipment covered by FAA specifications as part of the submittal package. The specifications shall be kept on file at the Contractor's airport construction office.

100-1.2 RELATED DOCUMENTS. The general provisions of the contract apply to the work specified in the items L-100, L-108, L-110, L-115, L-125, and as otherwise noted.

100-1.3 SUMMARY OF WORK. The work to be performed includes furnishing all labor, supplies, materials, equipment, transportation, and services required to augment, move, install, and complete electrical work as specified herein and as shown on the contract drawings.

The work includes, but is not limited to, the following:

(1) Maintain in operation, all existing field electrical facilities and circuits while this improvement work is in progress, including protection of airport personnel, aircraft, and vehicles; furnish and maintain temporary circuits, and place augmented airport lighting into operation. Field lighting shall be operable each night, each day when fog conditions exist, and when the airport calls an emergency.

- Remove and reinstall runway edge lights.

- Provide new runway counterpoise ground.
- Provide new runway edge light base cans.
- Provide new runway end light base cans.

(2) Provide underground cable (L-824) in accordance with specifications, at the locations shown on the plans. Test all circuit loops before and after installation of new cables to verify that no damage was caused by the Contractor.

(3) Remove and reinstall runway and taxiway edge lighting as noted on the Plans.

(4) Demolish existing underground conduits, counterpoise, base cans and additional items as noted on the Plans.

(5) Install new runway and taxiway edge lighting as noted on the Plans.

(6) Remove from the site existing equipment that is to be removed or replaced.

(7) Ground all equipment, enclosures, regulators, and conduits installed under this contract as shown in the plans, or as called for by the authority having jurisdiction.

(8) Other items required to complete foregoing. The omission of expressed reference to any parts necessary for or reasonably incidental to the complete installation shall not be construed as releasing the Contractor from furnishing and installing such parts at no extra cost to the Owner.

All items of general work required, such as excavation, cutting, patching, etc. shall be included in this Contract.

100-1.4 WORK REQUIREMENTS. The general work requirements are as follows:

a. All work shall be scheduled to minimize the impact and duration of shutdowns. The Contractor shall keep the Engineer informed of scheduled work which will affect existing equipment and operations. Minimum three (3) working days advance notice shall be given to the Engineer and approval received for any disconnections or shutdowns. All shutdowns shall then be coordinated with the Engineer.

b. Existing lighting systems shall be operational at the end of each working day at least 30 minutes prior to nightfall except as permitted by the Engineer. Poor weather visibility or an emergency situation may require postponement of a scheduled shutdown or reactivation of the system during an ongoing shutdown on any given day.

c. The plans are diagrammatic. Locations of equipment to be installed are shown in the plans, but the actual installation will depend on field conditions and the nature of the equipment furnished. When conditions which will adversely affect the installation become apparent, the Engineer shall be notified in writing.

d. Locations and quantities of materials shown on the plans and in these specifications are approximate and shall be used for estimating purposes only. Actual locations and quantities of materials shall be reviewed by the contractor through field investigation. No additional payment will be made for discrepancies between estimated quantities and locations of materials as shown in these documents and the actual field conditions.

e. The Contractor shall at all times keep the construction areas free from accumulations of waste material and rubbish, and prior to completion of work shall remove any rubbish from and about the project, as well as all tools, reels, equipment, and materials not a part of the project. Upon completion of the construction, the Contractor shall leave the work and premises in a clean, neat, and safe condition satisfactory to the Engineer. The Contractor shall be responsible for the proper performance in all respects, in whole and in part, of the electrical equipment and for the mechanical installation of electrical equipment until acceptance of the entire work by the Engineer.

100-1.5 SUBMITTALS. In addition to the requirements of Division 2, the Contractor shall include wiring diagrams, cut sheets, brochures, etc. of all equipment used on the job, including, but not limited to the items listed in these specifications and in the format described herein. The submittal package will not be reviewed unless 100% complete.

1.5.1 Submittal Format. The submittal shall consist of manufacturer's brochures and cut sheets describing the equipment and materials the Contractor plans to incorporate in the work. These sheets shall be sequentially ordered by specification number with the reference specification number shown on the bottom right of each sheet. Each cut sheet shall show the complete specification or drawing number which the item must comply with (i.e., L-108.2.3 and/or detail 3 on page E-4). Cut sheets shall be organized by the specification item number (L-100, L-108, etc.) with a tabbed divider sheet separating each item section. The submitted cut sheet shall clearly show the equipment manufacturer's name, catalog number, size, type, and/or rating as required by these specifications or drawings by underlining or circling the information.

The conformance to FAA criteria or other standards where called for shall be clearly indicated for each item. Each sheet shall be dedicated to one piece of equipment, and all sheets shall be sequentially numbered (i.e., 1/50; indicating page 1 of 50 total pages). One manufacturer's cut sheets shall be submitted for each item. All sheets shall be 8-1/2" x 11" or 17" x 11". When these sizes are unpractical, a folded 24" x 36" drawing may be substituted. All drawings shall be to scale. All sheets shall be bound in a 3-ring binder. Each submittal shall show on the cover the complete job name and number, date, contractor's name, and the words: "Electrical Submittal." The checklist shown in this specification shall be included as the first sheet of each submittal and shall show the page number of each item included in the submittal.

Samples of conduit, duct, fittings, cables, tapes, fixtures, etc., may be requested by the Engineer or required in these specifications. After they have been reviewed, samples will be returned in tested condition to the Contractor. In the event any items of material or equipment contained in the list fail to comply with specification requirements, such items will be rejected. All rejected items shall be amended to meet the criteria and then resubmitted for approval by the Engineer.

Substitutions of materials referenced herein is allowed when "or equal" is referenced. Any substitution shall be included in the submittal package.

1.5.2 Submittal Checklist. The contractor shall develop a submittal checklist and submit to the Engineer upon award.

100-1.6 DRAWINGS. The plans, which constitute an integral part of this Contract, shall serve as the working drawings. They indicate the extent and general layout of the lighting and signing system, arrangement of circuits, cables through ducts, connections to existing circuit cables, and other work. Field verification of scale dimensions is required to determine actual locations, distances, and levels. The Contractor shall research in the field the exact routing and identification of all circuits, which extend through, serve, or are affected by the area where work is to commence. No extra compensation will be allowed because of minor differences between work shown on the drawings and field conditions. The Contractor shall check the plans and specifications and, if any portion of the work is found to be omitted, unclear, or in error, the Contractor shall immediately notify the Engineer. The directions of the Engineer shall be followed and the work completed accordingly.

a. The design drawings may be utilized in the preparation of the shop or working drawings showing the permanent construction, as described in L-100.

b. The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.

c. Where a disagreement exists between the plans and specifications, or between plan sheets, the item or arrangements of better quality, greater quantity, or higher cost shall be included in the bid.

d. Any discrepancies between the drawings, Advisory Circulars, and field conditions must be resolved with the Engineer before proceeding. All agreements shall be verified in writing.

e. "Record" drawings covering equipment installed under previous contracts and which relate to this contract will be available for the Contractor. The airport cannot, however, guarantee the accuracy of these drawings. Those conditions that will affect the work under this Contract should be verified prior to any design/fabrication/installation commitment.

f. Detail dimensions shown on the plans are approximate and shall be field verified before construction. All differences shall be submitted to the Engineer in writing before construction begins.

100-1.7 RECORD DRAWINGS. The Contractor shall mark up a set of black line prints to show the as-built conditions which differ from the contract plans. All changes shall be recorded by a skilled draftsman with at least three years of drafting experience. The Engineer will furnish a newly printed set of blueline drawings to be used for this purpose. Record drawings will be checked monthly for accuracy and partial payments will be withheld until the record drawings are completely updated. The mark-up set shall be kept at the Contractor’s site office and not used for construction. Any changes or deviations shall be recorded in red within one week. The Contractor shall furnish the work as-built set and one newly printed record drawing set to the Engineer upon completion. This work shall be completed and accepted by the Engineer before approval of final payment.

100-1.8 MAINTENANCE AND OPERATING INSTRUCTIONS. The Contractor shall provide the Owner with complete instructions in the proper care and operation of the equipment installed under this contract. This is considered as part of the final inspection, and final acceptance will not be given until the Owner's representative is knowledgeable about the system.

The Contractor shall also collect and assemble into each of six (6) 3-ring binders the installation details, instructions, parts list, source of local supply, schematics of actual equipment and operations, and directions supplied by the manufacturer with all equipment. Topics shall be separated with index tabs. Provide with a Table of Contents. If cut sheets are included showing various models and features of the equipment supplied, the specific model and features shall be clearly indicated to show only the options of the equipment that are actually provided and installed. Final acceptance of the work will not be made until such data has been presented complete to the Engineer for transmission to the Owner.

The Contractor shall install all equipment according to the manufacturers' instructions and as shown in the drawings and specifications. The Contractor shall notify the engineer in writing if any discrepancies exist between the aforementioned documents. Work shall be suspended until resolved and approval to proceed has been granted by the Engineer.

100-1.9 TRAINING. The Contractor shall provide the airport maintenance staff training on the operation and maintenance of the new regulators and signs. Manufacturer's technicians or personnel who are trained and qualified for this purpose shall perform this instruction. Training shall be coordinated through the Engineer with the availability of the Owner's personnel. Two weeks advance notice of training dates shall be given.

The follow up training shall occur 6 months after the initial training or as requested by the Engineer.

100-1.10 SAFETY RULES. The Electrical Safety Rules shall be observed and complied with in every detail, and any violation thereof shall be cause for immediate termination of the Contractor's authority to proceed with the work and recourse to his Surety for completion of the Project. The Electrical Safety Rules are as follows:

a. The Contractor shall be responsible for conforming with the safety requirements of Appendix 1 to AC 150-5370-2G and Owner mandated safety procedures.

b. Electrical circuits, operating over 300 volts, phase-to-ground shall be deenergized before work is accomplished thereon. Work on energized systems shall be accomplished by trained personnel, properly insulated, and done with extreme caution.

c. Electrical circuits shall be considered deenergized only when one of the following conditions exists:

(1) Switches connecting subject circuit to the electrical supply are observed in the OPEN position, with an air break, and safety-tagged (padlocked) in the OPEN position;
(2) Electrically operated switches are visibly OPEN, blocked or racked in the OPEN position, and safety-tagged OPEN;
(3) Whenever the supply circuit break is not visible and clearly identified, the circuit shall be grounded. The ground connection shall be safety-tagged before work thereon, when the ground connection is not within sight of the work area.
(4) Oil switches observed OPEN in a sight window and tagged OPEN; or oil fuse cutouts with fuse carrier removed and tagged OPEN.

d. Use of Red Safety Tags:

(1) Safety tags shall be filled out and connected to any switch or equipment opened for protection of personnel working upon circuits connected thereto.
(2) Safety tags shall be removed only by the employee who placed the tag, or by another employee designated in writing by the employee who placed the tag, to remove the tag. Removal of a safety tag placed by an employee not available at the time of need to remove,

may be authorized by the Electrical Superintendent or his designated representative, only after carefully checking that the circuit is ready to be energized.

(3) Equipment with a safety tag attached shall not be operated, and connections with a safety tag attached shall not be changed.

(4) Insulated cables, operated at over 300 volts to ground shall be handled, when energized, only with rubber gloves tested to 15,000 volts.

(5) Insulated cables, which have been in operation, shall be cut only with a grounded cable shears, or shall be grounded by driving a grounded sharp tool through the shielding and the conductors before cutting.

(6) All personnel working around energized electrical equipment operating at over 600 volts shall wear standard insulated, nonconducting hard hats, and shall wear no garments with metallic zipper fasteners.

(7) Ladders used in any electrical work shall be of wood or fiberglass construction.

(8) The Contractor shall designate a supervisor for all contract personnel and operations, said supervisor shall be on the job wherever contract operations are in progress.

100-1.11 CONTRACTOR QUALIFICATIONS. Work shall be performed by a contractor licensed in the State of Florida, with a minimum of five years of electrical contracting experience in airfield electrical systems.

EQUIPMENT AND MATERIALS

100-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified by independent laboratory testing to be in compliance with the specification.

b. Equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer. Whenever Underwriters Laboratories has a published standard applicable to the equipment furnished for this contract, the furnished equipment shall be listed by UL.

c. Materials and equipment shall be as specified herein. When materials are used that are not specifically designated herein, they shall be in accordance with the best industry standards and practices for equipment of this type. All components and parts shall be suitable for operation under the environmental conditions specified herein. Metal parts shall be either inherently corrosion-resistant or shall be suitably protected to resist corrosion or oxidation during extended service life.

100-2.2 HARDWARE CORROSION PROTECTION. In order to prevent deterioration due to corrosion, all bolts, nuts, studs, washers, pins, terminals, springs, hangers and similar fastenings and fittings shall be of an approved corrosion-resisting material and/or be treated in an approved manner to render it adequately resistant to corrosion. All hardware such as cap screws, set screws, tap bolts, nuts, washers, etc., shall be of stainless-steel type 304, SAE Grade 2, if they are used outdoors unless specified otherwise on the plans. Brass, bronze, or hot-dip galvanized ferrous hardware (per ASTM, Specification A1530) will be considered for indoor use. All bolts, screws, nuts, etc., shall be coated with a layer of "Neverseize" compound or approved equal.

All ferrous metalwork shall be galvanized. If any galvanizing is damaged, the metal work shall be refinished by cleaning, treating with one coat of wash primer conforming to Federal (military) Specification MIL-P-152388, and shall be given one shop coat of zinc-rich base paint (zinc dust paint) conforming to Federal Specification TT-P-641F Type II, immediately when the wash primer is dry.

100-2.3 PARTS RATING. All parts shall be of adequate rating for the application and shall not be operated above the parts manufacturer's recommended ratings.

100-2.4 ENVIRONMENTAL CONDITIONS. The equipment installed outdoors shall be designated for continuous outdoor operation under the following environmental conditions unless specified elsewhere:

a. Temperature: Any ambient temperature from minus 20°F to plus 120°F.

b. Altitude: 100 MSL.

c. Humidity: Up to 100 percent.

d. Sand and Dust: Exposure to windblown sand and dust particles.

e. Wind: Operation at wind velocities up to 120 miles per hour.

f. Water: Components provided for underground installation, direct buried or installed in underground housing, shall be suitable for continuous operation, continuously or intermittently submerged in water.

100-2.5 SALVAGE. Except as otherwise specified or indicated on the drawings, all electrical materials and equipment to be salvaged, removed, or "stored" shall become the property of the Airport, and shall be moved by the Contractor to a site at the airport or within 5 miles of the airport designated by the Engineer. All wastes such as removed asphalt, concrete, excess excavation, conductors, damaged base cans, etc., shall become property of the Contractor and shall be disposed of off site by the Contractor. Provide receipt of proper disposal.

100-2.6 TESTING. All materials and finishes are subject to testing. Material inspection and testing, and strength tests on the concrete will be performed by the Airport at no expense to the Contractor other than material used. The Contractor shall assist the Engineer in obtaining samples during the course of construction work. The testing of electrical equipment shall conform to the description of the individual specification sections.

100-2.7 INSPECTION. Provide for electrical inspections by the authority having jurisdiction. No work shall be concealed or enclosed until after inspections. If work is concealed or enclosed without inspection and approval, the Contractor shall be responsible for all expense and work required to open and restore the concealed area in addition to all required modifications.

Mill inspection will be waived, and the materials accepted upon certified copies of mill reports identifying the material specification requirements. Copies of order bills and test reports shall be furnished as requested.

100-2.8 WARRANTY. The Contractor shall provide a written 1-year warranty guaranteeing all work installed under this contract. It shall cover all parts and labor against defective parts, corrosion or workmanship necessary to repair or bring into proper operation any equipment including, but not limited to, isolation transformers, lamps, edge lights, apron lighting fixtures, poles, transformers circuit breakers, conduit system, and junction boxes. The warranty shall start upon the acceptance of all work as accepted by the Engineer. Final payment will be withheld until receipt of the warranty by the Engineer.

CONSTRUCTION METHODS

100-3.1 GENERAL. Installation shall be performed by experienced and skilled persons to obtain only the best workmanship. All equipment shall be set square and true with construction. The work shall be under constant supervision by the Contractor, or by an authorized and competent foreman with five years experience, until completion.

100-3.2 INSTALLATION METHOD. The methods used for the installation of electrical system and equipment shall conform to the National Electric Contractors Association (NECA) published "Standard of Installation" except where specifically specified or shown otherwise, and to the requirements of the National Electrical Code (NEC) and its revisions as adopted by the local agency having jurisdiction.

All electrical materials, construction methods, and installation shall be in accordance with applicable Federal Aviation Administration's advisory circulars including amendments, the National Electrical Code, and the American National Standards Institute Standard C2.

The workmanship shall be first class and in accordance with the highest standards of the electrical industry and consistent with the best commercial practices. The installations and adjustments shall be by competent electricians.

The responsibility for the correct and satisfactory installation and operation of all materials and equipment required herein shall rest with the Contractor. Before any equipment is ordered, a complete schedule of materials and detailed shop drawings covering all items of equipment and brochures of the materials proposed for installation shall be submitted for approval by the Engineer as described in Item L-100.

100-3.3 SITE CONDITIONS. At least five (5) working days prior to commencing construction operations in an area which may involve underground utility facilities, the Contractor shall notify the Engineer of each underground utility facility shown on the plans. When coordinated with the Engineer, the FAA will assist the Contractor in locating existing FAA cables.

The existence of any known buried wires, conduits, junction boxes, ducts, or other facilities is shown in a general way only. It will be the duty of the Contractor, with the help of airport personnel, to visit the site and make exact determination of the existence and location of any facilities prior to commencing any work. It is understood that the Contractor will be responsible for making the exact determination of the location and condition of such facilities and any costs shall be paid for locating services by the Contractor. The Contractor shall obtain from the Engineer copies of contract drawings from previous construction projects, examine these drawings, and verify at the site the location of all below grade utilities in the vicinity of work performed under this Contract.

All items damaged by the Contractor's workers or equipment shall be replaced immediately at the Contractor's expense.

100-3.4 INTERRUPTIONS. Interruptions of lighting circuits may be necessary during construction. The Contractor shall provide a reliable shunt cable to provide temporary continuity of circuit service to runway and taxiway lights and signs during construction where required. The Contractor shall not interrupt any circuit or perform any work that might endanger any circuit until approval of the Engineer has been received. Temporary cables shall be protected and identified as a hazard.

The Contractor shall be responsible for installing, maintaining, protecting, and removing all required temporary jumper cables used to maintain power to electrical circuits.

For the permanent installation, all temporary connections and rerouting of circuits shall be replaced with new materials installed in accordance with the specifications and as shown on the plans.

The Contractor shall remove all circuit cables from their respective electrical power sources in the vault before working on the cables in the field. All such cables shall be so marked at the point of disconnection to prevent accidental reconnection. This work is incidental to the electrical work and no separate payment will be made. See item L-100, SAFETY RULES.

100-3.5 CODES. The Contractor shall comply with all ordinances, laws, regulations, and codes applicable to the work involved and as referenced in these specifications. This does not relieve the Contractor from furnishing and installing work shown or specified which may be beyond the requirements of such ordinances, laws, regulations, and codes.

100-3.6 SAFETY AREA. The Contractor shall abide by the requirements of the Contract Specifications when working within the runway or taxiway safety areas or as directed by the Engineer.

METHOD OF MEASUREMENT

100-4.1 The pay item for Electrical Demolition shall be per linear foot the electrical Demolition, Circuit tracing, existing condition verification, miscellaneous electrical prep, disconnections and all incidentals as required to provide complete demolition of identified services. No direct measurement or payment shall be made for cutting conduits and temporary caps (to avoid dirt intrusion) during construction. Conduit cutting and temporary caps shall be incidental to demolition.

BASIS OF PAYMENT

100-5.1 Payment will be made at the Contract unit price for the demolition of existing electrical services in preparation for new work. Payment will be full compensation for demolishing all materials and for all labor, supervision, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

Item L-100-5.1	Electrical demolition, circuit tracing, existing condition verifications, misc electrical prep – per linear foot

MATERIAL REQUIREMENTS

AC 150/5370-2C	Operational Safety on Airports During Construction
AC 150/5370-10	Standards for Specifying Construction of Airports
MIL-P-152388	Wash Primer Specification
TT-P-641F	Type II, Base Paint, Zinc-Rich

END OF ITEM L-100

ITEM L-108S
UNDERGROUND POWER CABLE FOR AIRPORTS
SUPPLEMENT

DELETE THE ENTIRE SPECIFICATION AND INSERT THE FOLLOWING:

DESCRIPTION

108-1.1 This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities. Requirements and payment for trenching and backfilling for the installation of underground conduit and duct banks is in Item L-110, Airport Underground Electrical Duct Banks and Conduits.

EQUIPMENT AND MATERIALS

108-2.1 GENERAL

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall be responsible to maintain a minimum insulation resistance per AC 150/5340-26B, Maintenance Airport Visual aid Facilities, Table 5-1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

Only Third Party certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the Contract Documents. Documentation certifying compliance with the BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC §50101) shall be included with each equipment and material submittal.

108-2.2 CABLE. Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7F, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge AWG), L-824 Type C, 5,000 volts, nonshielded, with cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824 Type C, 5,000 volts, nonshielded, with cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Federal Specification J-C-30 and shall be type THWN-2, 75°C. Conductors for parallel (voltage) circuits shall be sized and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108-2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND PER WIRE GROUND AND GROUND RODS). Wire for counterpoise or ground installations for field lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for ground wire per ASTM B3 and ASTM B8, and shall be bare copper wire per ASTM B33. See AC 150/5340-30 for additional details about counterpoise and ground wire types and installation. For voltage powered circuits, the equipment ground conductor shall be minimum No. 6 AWG, 600V rated, Type XHHW insulated, green color, stranded copper equipment ground conductor.

Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 10 feet long and 3/4 inch in diameter.

108-2.4 CABLE CONNECTIONS. In-line connections or splices of underground primary cables shall be of the type called for on the plans and shall be one of the types listed below. No separate payment will be made for cable connections.

a. The cast splice. A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or as manufactured by Hysol® Corporation, "Hyseal Epoxy Splice" Kit No. E1135, or an approved equivalent, used for potting the splice is acceptable.

b. The field-attached plug-in splice. Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is acceptable for field attachment to single conductor cable. It shall be the Contractor's responsibility to determine the outside diameter of the cable to be spliced and to furnish appropriately sized connector kits and/or adapters and heat shrink tubing with integral sealant.

c. The factory-molded plug-in splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. The taped or heat-shrink splice. Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. See AC 150/5340-30 for additional information about methods of attaching a ground to a galvanized light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

108-2.5 SPLICER QUALIFICATIONS. Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the Engineer proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.6 CONCRETE. Concrete for cable markers shall be per Specification Item P-610, Structural Portland Cement Concrete.

108-2.7 FLOWABLE BACKFILL. Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

108-2.8 CABLE IDENTIFICATION TAGS. Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

108-2.9 TAPE. Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108-2.10 ELECTRICAL COATING. Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

108-2.11 EXISTING CIRCUITS. Whenever the scope of work requires connection to an existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The Contractor shall record the results on forms acceptable to the Engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108-2.12 DETECTABLE WARNING TAPE. Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches wide. Detectable tape is incidental to the respective bid item.

CONSTRUCTION METHODS

108-3.1 GENERAL. The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Wherever possible, cable shall be run without splices, from connection to connection.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed or at least once in each access point where L-823 connectors are not installed.

Provide not less than 3 feet of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Engineer.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

108-3.2 INSTALLATION IN DUCT BANKS OR CONDUITS. This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor’s expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cables shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer’s recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor’s expense.

The manufacturer’s minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer’s recommendations. During cold weather, particular attention shall be paid to the manufacturer’s minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer’s minimum installation temperature. At the Contractor’s option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer’s minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

108-3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES. Not used.

108-3.4 CABLE MARKERS FOR DIRECT-BURIED CABLE. Not used.

108-3.5 SPLICING. Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Cast splices. These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer's instructions and to the satisfaction of the Engineer.

b. Field-attached plug-in splices. These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint.

c. Factory-molded plug-in splices. These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint.

d. Taped or heat-shrink splices. A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108-3.6 BARE COUNTERPOISE WIRE INSTALLATION FOR LIGHTNING PROTECTION AND GROUNDING. Bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables, using the following method, based on the frequency of local lightning:

a. Equipotential. The counterpoise size is as shown on the plans. The equipotential method is applicable to all airfield lighting systems; i.e. runway, taxiway, apron – touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases, counterpoise, etc – all components - are bonded together and bonded to the vault power system ground loop/electrode**.**

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered over the cable/conduit/duct to be protected.

The counterpoise conductor shall be installed no less than 8 inches (200 mm) minimum or 12 inches (300 mm) maximum above the raceway or cable to be protected, except as permitted below:

(1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

(2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45 degrees on each side of vertical creating a 90 degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Equipotential Method of lightning protection.

Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.][not used]

A separate equipment (safety) ground system shall be provided in addition to the counterpoise wire using one of the following methods:

A ground rod installed at and securely attached to each light fixture base, mounting stake, and to all metal surfaces at junction/access structures via #6 AWG wire.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

108-3.7 COUNTERPOISE INSTALLATION ABOVE MULTIPLE CONDUITS AND DUCTS BANKS. Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete cone of protection measured 22-1/2 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

108-3.8 COUNTERPOISE INSTALLATION AT EXISTING DUCT BANKS. When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108-3.9 EXOTHERMIC BONDING. Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.

c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

108-3.10 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

d. That all affected circuits (existing and new) are free from unspecified grounds.

e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 50 megohms.

f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

g. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

h. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved “repair” procedures for items that have failed testing other than complete replacement.

METHOD OF MEASUREMENT

108-4.1 The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work.

108-4.2 Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall include additional quantities required for slack.

108-4.3 Ground rods shall be measured by each 3/4-inch x 10 foot-section installed complete. Additional 10-foot sections will be measured, as required to meet testing requirements.

108-4.4 This item shall include all requirements to provide continuity of source and downstream circuits to new equipment. This shall include disconnection of existing equipment from items being demolished, removal of existing cabling to equipment, manholes, and devices outside the scope of work which are to remain, cutting of existing conduits and any ductbanks to make ready for new conduits extending, preparing existing conduits for extensions, and connections of cabling to source/downstream devices. Payment will be made at the contract unit price for each circuit interception/extension.

BASIS OF PAYMENT

108-5.1 Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item. **Payment for ground rods, including ground connectors, will be made for each 3/4-inch x 10-foot section installed. Payment will be made for additional 10-foot sections required to meet testing requirements.**

Payment will be made under:

Item L-108-5.1	No. 8 AWG, 5 kV, L-824 Type C Cable, Installed in Duct Bank or Conduit - per linear foot
Item L-108-5.2	No. 6 AWG, Bare Solid Copper Counterpoise Wire, Installed in Trench - per linear foot

Item L-108-5.3	3/4 ” x 10’ Copper Clad Steel Ground Rods, Including Ground Connectors - per each
Item L-108-5.4	Intercept Existing Circuit Conductors in Existing Base Can / Manhole / Junction Can and Extend Circuits – per each
Item L-108-5.5	10’ Additional Ground Rod Sections - per each

MATERIAL REQUIREMENTS

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program
Commercial Item Description A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)
Commercial Item Description A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
FED SPEC J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

REFERENCE DOCUMENTS

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems
MIL-S-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

END OF SECTION

SECTION L-108
INSTALLATION OF UNDERGROUND CABLE FOR AIRPORTS

DESCRIPTION

108-1.1 The work under this Section consists of furnishing and installing underground cable in accordance with these specifications at the locations shown in the plans. This item shall include the excavation and backfill of the trench and the installation of cable and counterpoise wire in trench, duct or conduit. It shall include splicing, cable marking, and testing of the installation and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Architect/Engineer. The work shall also include the furnishing and installing of temporary wiring and modifications of existing taxiway and runway circuits as shown on the Plans. This Section shall not include the installation of the duct or conduit.

EQUIPMENT AND MATERIALS

108-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and are listed in the current issue of FAA Advisory Circular (AC) 150/5345-1, Approved Airport Equipment.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification.

108-2.2 CABLE. Underground cable shall be Type C, cross-linked polyethylene insulation, rated for 5000 volts, conforming to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits, and shall have a neoprene jacket applied overall.

All cable for airport runway and taxiway lighting service shall be stranded copper 5000 volt 19 strand. Power cable conductor size shall not be smaller than No. 8 AWG. Control cable conductor size shall be not less than No. 12 AWG. These limits on conductor sizes shall not apply to leads on transformers and fixtures.

Telephone control cable shall be copper shielded, polyethylene insulated and jacketed, No. 19 AWG telephone cable conforming to the United States Department of Agriculture, Rural Electrification Administration (REA) Bulletin 345-14, REA Specification for Fully Color-Coded, Polyethylene Insulated, Double Polyethylene-Jacketed Telephone Cables for Direct Burial.

Cable type, size, number of conductors, strand and service voltage shall be as shown in the Plans.

FAA Facilities Power and Control Cable and Installation procedures shall be as set forth in the following Specifications:

a. FAA-E-2013a, July 3, 1972 and Amendment No. 2 dated February 13, 1975.

b. FAA-E 20272a, dated March 19, 1974.

c. FAA-C-1391a, December 4, 1973 and Southern Region Addendum No. 1 dated February 9, 1978.

108-2.3 COPPER COUNTERPOISE WIRE. Bare or TW insulated copper wire for counterpoise installations shall be No. 6 AWG, stranded, soft drawn wire conforming to ASTM Specifications B 3 and B 8.

Where soil conditions would adversely affect bare copper wire counterpoise conductors, thermoplastic wire insulation conforming to Fed. Spec. J-C-30, Type TW, 600 volt, may be used.

108-2.4 CABLE CONNECTIONS. In-line connections of underground primary cables shall be of the type called for in the Plans and shall be one of the types listed below.

a. The Field-attached Plug-in Splice. Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is approved for field attachment to single conductor cable.

b. The Factory-Molded Plug-in Splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, are approved.

c. All cable splices shall be furnished with heat shrinkable rubber sleeves.

108-2.5 CONCRETE. Concrete for cable markers shall be Class II conforming to Specification Section P-610, "Structural Portland Cement Concrete."

CONSTRUCTION METHODS

108-3.1 GENERAL. The Contractor shall install the specified cable at the locations shown on the Plans. Installation shall comply with all laws applying to electrical installation in effect, with the regulations of the current edition of the National Electrical Code, National Electrical Safety Code, other applicable publications of the National Fire Protection Association, and all local governing codes and ordinances and with the regulations of any affected utility company.

FAA supplied cables shall be meggered on the reels by the Contractor prior to installation.

Cable connections in light runs shall be made at the connections on underground to primary leads of individual insulating transformers.

The Contractor shall provide cables in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Architect/Engineer or shown in the plans.

108-3.2 INSTALLATION IN DUCT OR CONDUIT. The maximum number and voltage ratings of cables installed in each single duct or conduit and the current-carrying capacity of each cable shall be in accordance with the latest National Electric Code or the code of the local agency having jurisdiction.

The Contractor shall make no connections or joints of any kind in cables installed in conduits or ducts. No grounding conductors shall be installed within the ducts or conduits.

The duct or conduit shall be installed as a separate item in accordance with the requirements of Section L-110, "Installation of Airport Underground Electrical And Communications Ducts." The Contractor shall make sure that the duct is open, continuous, and clear of debris before installing cable. The cable shall be installed in a manner to prevent stretching of the conductor, injury to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a duct, all cable shall be pulled in the duct at the same time. The pulling of a cable through ducts or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Pulling tensions shall be governed by cable manufacturers' recommended practices for straight pulls or bends. A lubricant recommended for the type of cable being installed shall be used as pulling lubricant. Duct or conduit markers temporarily removed for excavations shall be replaced as required.

108-3.3 TRENCHING. Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Trenching, support of excavation and backfilling shall be performed in accordance with the applicable requirements of Section P-701. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Road patrols or graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches below finished grade, except as follows:

a. When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches *(90 cm)* unless otherwise specified.

b. Minimum cable depth when crossing under a railroad track shall be 42 inches unless otherwise specified.

Unless otherwise shown on the Plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

When rock excavation is encountered, the rock shall be removed to a depth of at least 3 inches *(75 mm)* below the required cable depth and it shall be replaced with approved bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch *(6.25 mm)* sieve.

108-3.4 INSTALLATION IN TRENCHES. The Contractor shall not use a cable plow for installing the cable. Mechanical cable-laying equipment may be used in conjunction with a trenching machine, subject to approval by the Architect/Engineer. The Contractor shall inspect the cable for defect or damage prior to backfilling. Cables installed with sharp bends or kinks shall be removed and replaced at no cost to the County.

All cables shall be installed with a minimum four (4) inch *(100 mm)* encasement of onsite granular soil, containing no particles greater than 1/4 inch *(6.25 mm)* in diameter.

Cables shall be unreeled in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end.

Where two or more cables are laid parallel in the same trench, they shall be laterally separated a minimum distance of 3 inches apart, and the trench shall be widened sufficiently to accomplish this.

Cables crossing over each other shall have a minimum of 3-inch *(75 mm)* vertical separation with the topmost cable depth at or below the minimum required depth below finished grade.

Not less than 1 foot *(30 cm)* of cable slack shall be left on each side of all connections, insulating transformers, light units, and at all other points where cable is connected to field equipment. The slack cable shall be placed in the trench in a series of S curves. Additional slack cable shall be left in runway light bases, handholes, manholes, etc., sufficient to bring the cable above ground level to make connections. The amount of slack cable shall be as stipulated by the Architect/Engineer or as shown in the Plans or Specifications.

108-3.5 BACKFILLING. After the cable has been installed, the trench shall be backfilled. The first layer of backfill shall be 4 inches *(100 mm)* deep, loose measurement, and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch *(6.25 mm)* sieve. This layer shall not be compacted. The second layer shall be 5 inches *(125 mm)* deep, loose measurement, and shall contain no particles that would be retained on a 1-inch (*25 mm)* sieve. The remainder of the backfill shall be excavated or imported granular material containing no aggregate larger than 4 inches *(100 mm)* maximum diameter. The third and subsequent layers of the backfill shall not exceed 8 inches *(200 mm)* in maximum depth, loose measurement.

The second, and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent undisturbed soil in accordance with MDAD T-611. The backfill material shall be moistened or aerated as required to achieve specified compaction.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement. Excess excavated material shall be removed and disposed of in accordance with the Architect/Engineer's instructions.

108-3.6 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction, and other work shall be restored to its original condition. The restoration shall include any necessary topsoiling, fertilizing, seeding, sodding, and sprigging. All such work shall be performed in accordance with the applicable requirements of Sections T-903 and T-904. The Contractor shall be responsible for maintaining all disturbed surfaces and replacements until final acceptance.

108-3.7 CABLE MARKERS. The location of light circuits in unpaved areas shall be marked by a square concrete slab marker, 2' x 2' *(60 cm x 60 cm)* and 4 inches *(100 mm)* thick, extending approximately 1 inch *(25 mm)* above the surface. Each cable run from the line of lights to the equipment vault shall also be marked at approximately every 200 feet *(60 m)* along the cable run, with an additional marker at each change of direction of cable run. All other cable buried directly in the earth shall be marked in the same manner. Slab markers shall not be installed where cable lies in straight lines between lights which are spaced 300 feet *(90 m)* apart, or less. Cable markers shall be installed immediately above the cable. The Contractor shall impress the word "CABLE" and directional arrows on each cable marker.

The location of each underground cable connection, except at lighting units or insulating transformers, shall be marked by a cable marker placed above the connection. The Contractor shall impress the word "SPLICE" on each slab. He shall also impress additional circuit identification symbols on each slab as directed by the Architect/Engineer.

The size of the letter impressed in the markers shall be approximately 4 inches *(100 mm)* high and 3 inches *(75 mm)* wide, with width of stroke 1/2 inch *(12.5 mm)* and 1/4 inch *(6.25 mm)* deep.

108-3.8 SPLICING. Connections of the type shown in the plans shall be made using field attached or factory molded plug-in splices and performed by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Field-attached Plug-in Splices. These shall be assembled in accordance with manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. Heat shrinkable rubber sleeves shall be installed over all connections and splices.

b. Factory-Molded Plug-in Splices. These shall be made by plugging directly into mating connectors. Heat shrinkable rubber sleeves shall be installed over all connections and splices.

c. Splicing of FAA Power and Control Cables shall be performed by FAA Facilities Technicians.

108-3.9 COUNTERPOISE WIRE INSTALLATION AND GROUNDING FOR LIGHTNING PROTECTION. Stranded bare or TW insulated copper wire, No. 6 AWG minimum size, shall be installed for lightning protection of the underground cables. The counterpoise wire shall be installed in the same trench for the entire length of the duct bank or the insulated cables it is designed to protect, shall not be embedded in the concrete encasement, and shall be placed at a distance of approximately 6 inches *(150 mm)* above the duct bank or the insulated cables. The counterpoise wire shall be securely attached to each light fixture base or mounting stake. The counterpoise wire shall also be securely attached to copper or copper-clad ground rods installed not more than 400 feet *(120 m)* apart around the entire circuit. The ground rods shall be of the length and diameter specified in the plans, but in no case shall they be less than 10-feet *(3 m)* long nor less than 3/4 inch *(19 mm)* in diameter.

The counterpoise system shall terminate at ground rods installed immediately ahead of the transformer vault. The counterpoise system shall not be connected to the vault grounding system. The connections shall be made as shown in the project plans and specifications.

108-3.10 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the underground cable circuits after installation. The

Contractor shall test and demonstrate to the satisfaction of the Architect/Engineer the following:

a. That all lighting power and control circuits are continuous and free from short circuits.

b. That all circuits are free from unspecified grounds.

c. That the insulation resistance to ground of all nongrounded series circuits is not less than 50 megohms.

d. That the insulation resistance to ground of all nongrounded conductors of multiple circuits is not less than 50 megohms.

e. That all circuits are properly connected in accordance with applicable wiring diagrams.

f. That all circuits are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

g. That all procedures are followed and forms submitted as mandated by the MDAD Commissioning Program, per Standard Technical Specification Section 01810 – Commissioning Requirements.

METHOD OF MEASUREMENT

108-4.1 Measurement of Cable Trench for payment shall be the number of linear feet of trench, including the excavation, backfill, and reconditioning, completed, measured in place complete, and accepted in accordance with the Plans and Specifications.

108-4.2 Measurement for Cable and Counterpoise Wire for payment shall be the number of linear feet of cable installed in trench or duct and the number of linear feet of counterpoise wire installed in trench measured in place, complete and accepted in accordance with the Plans and the Specifications. Separate measurement shall be made for each cable or counterpoise wire installed in trench or duct.

The following allowances for cable slack shall be applied for each separate cable:

1% for slack in trenches or duct, but not less than 1.0 foot *(30 cm)* on each side of each connection.

8 feet *(2.4 m)* [4 feet *(1.2 m)* per leg] for connections inside each base mounted light.

There shall be no separate measurement and payment of ground rods for payment. Payment for ground rods shall be included in the price bid for counterpoise wire.

BASIS OF PAYMENT

108-5.1 Payment for Cable Trench, measured as described above shall be made the Contract Unit Price bid per linear (foot) *(meter)* for Cable Trench, which price and payment shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the work under this Section.

108-5.2 Payment for Cable of the various types and sizes, installed in trench or duct, measured as described above, shall be made at the Contract Unit Price bid per linear (foot) *(meter)* for No. ___ Airport Cable, No. 6 Counterpoise Wire, and ____PR #19 Control Cable, which prices and payment shall be full compensation for furnishing and installing all materials, including ground rods incidental to the Counterpoise Wire, and for all labor, equipment, tools and incidentals necessary to complete the work under this Section.

Payment will be made under:

Item No.	Cable Trench	per linear (foot) *(meter)*
Item No.	No. _____ Airport Cable	per linear (foot) *(meter)*
Item No.	No. 6 Counterpoise Wire	per linear (foot) *(meter)*
Item No.	_____PR #19 Control Cable	per linear (foot) *(meter)*

MATERIAL REQUIREMENTS

AC 150/5345-1	Approved Airport Equipment
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle Cable Connectors
Fed.Spec. J-C-30	Cable and Wire, Electrical Power, Fixed Installation
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard, or Soft
~~DCAD~~***MDAD*** P-610	Structural Portland Cement Concrete
~~DCAD~~***MDAD*** T-611	Compaction Control Tests National Electric Code
REA Bulletin 345-14	Rural Electrification Administration, Department of Agriculture.

CHECKLIST FOR UNDERGROUND CABLE

1. __________ Is the underground cable approved by FAA and listed in the latest issue of AC 150/5345-1?

2. __________ Is the underground cable marked to show manufacturer or trademark, FAA L-824, conductor size, voltage rating and type?

3. __________ Are all insulated and bare conductors made of copper?

4. __________ Are all insulated and bare conductors stranded?

5. __________ Are ends of cable taped whether the cable is on reels, beside the trench, in the trench, in a light base, in a manhole or awaiting connection to an isolating transformer?

6. __________ Are the L-823 connectors of proper size and do they properly fit the cable?

7. __________ Are the connector joints wrapped with a heat shrinkable sleeve?

8. __________ Are there no splices in the ducts or between the lights?

9. __________ Where splices are permitted by the contract, is splicing performed in accordance with approved FAA methods?

10. __________ Is the cable installed without kinks or sharp bends?

11. __________ Where more than one cable is being installed in the same trench are they separated laterally by a minimum distance of 3 inches?

12. __________ Is trenching being done by using proper equipment? (Road patrols and graders are not to be used for trenching). Also, cable plows may not be permitted for cable installation unless specifically authorized by the contract documents.

13. __________ Is the cable trench of required depth and width? Especially note the trench depth at roadway and railroad track crossings.

14. __________ Is the bedding at least 4 inches *(100 mm)* deep and contains no mineral aggregate particles that would be retained on a 1/4" *(6.25 mm)* sieve?

15. __________ Is the cable unreeled alongside the trench or in the trench and carefully placed along the bottom of the trench and not pulled into the trench from one end?

16. __________ Where Cable is buried directly in the ground, is there at least one foot of cable slack being left on each side of all connections?

17. __________ Is the cable trench being properly backfilled with proper size materials for each layer and is each layer thoroughly tamped and compacted as required/

18. __________ Is the counterpoise wire being installed at 6" *(15 cm)* above the cables?

CHECKLIST FOR UNDERGROUND CABLE (Continued)

19. __________ Are copper-clad ground rods of proper diameter and lengths being installed at locations shown and at least every 400 feet *(120 m)* along entire length of counterpoise wire system?

20. __________ Is the counterpoise wire being securely attached to ground rods, each light base and/or stake?

21. __________ Is cable installed at the specified minimum depth for the direct buried cable.

22. __________ Are trenches free from pools or water and not excessively wet during backfilling operations?

23. __________ Is excess excavated material removed and properly disposed of?

24. __________ Where sod has been removed for trenching, has the sod been replaced as soon as possible after backfilling operations?

25. __________ Have areas disturbed by trenching, storing of dirt, cable laying, cable marker construction, and other work been restored to satisfaction of airport sponsor?

26. __________ Does the new underground cable lighting circuit meet the insulation resistance requirements of not less than 50 megohms?

27. __________ Are HV and cables properly separated in handholes and manholes in accordance with NEC Article 300?

28. __________ Are the cables identified in all handholes, manholes, and wireways?

29. __________ Are cable markers installed at each change in direction of cable run and every 200 feet along straight cable runs?

30. __________ Are the cable markers of proper size and are they securely and otherwise properly installed?

31. __________ Are the markings on cable correct and neatly inscribed?

32. __________ Is sufficient cable slack left in cans to bring all connections above ground level?

END OF SECTION

ITEM L-110S
AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS SUPPLEMENT

DELETE the entire specification and **INSERT** the following:

DESCRIPTION

110-1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete, installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

EQUIPMENT AND MATERIALS

110-2.1 General.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

110-2.2 Plastic conduit. Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

110-2.3 Split conduit. Split conduit shall be pre-manufactured for the intended purpose and shall be made of plastic.

110-2.4 Conduit spacers. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high-grade, high-density polyethylene, complete with interlocking cap and base pads, they shall be designed to accept No. 4 reinforcing bars installed vertically.

110-2.5 Concrete. Concrete shall conform to Item P-610, Structural Portland Cement Concrete, using 1-inch maximum size coarse aggregate with a minimum 28-day compressive strength of **4,000** psi. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

110-2.6 Flowable backfill. Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material. Fill shall be designed to achieve a 28-day compressive strength of 200 psi (1.4 MPa) under pavement.

110-2.7 Detectable warning tape. Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit, and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item. **Legend shall read "DANGER – ELECTRICAL LINE BELOW."**

CONSTRUCTION METHODS

110-3.1 General. The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches per 100 feet. On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. No duct bank or underground conduit shall be less than 18 inches below finished grade. Where under pavement, the top of the duct bank shall not be less than 18 inches below the subgrade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200-pound test polypropylene pull rope. The ends shall be secured, and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet.

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxi lanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6 mm) sieve. Flowable backfill may alternatively be used The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Alternatively, additional duct bank supports that are adequate and stable shall be installed, as approved by the Engineer.

All excavation shall be unclassified and shall be considered incidental to the respective L-110 pay item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay item as a part of Item L-110. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-110 Item.

Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the Engineer and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

b. Trenching, etc., in cable areas shall then proceed with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

110-3.2 Duct banks. Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet beyond the edges of the pavement or 3 feet beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches thick prior to its initial set. The Contractor shall space the conduits not less than 3 inches apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches wide tape, 8 inches minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch-wide tape only for single conduit runs. Utilize the 6-inch-wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the Engineer.

110-3.3 Conduits without concrete encasement. Trenches for single-conduit lines shall be not less than 6 inches nor more than 12 inches wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4-inch sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches below the finished grade per National Electric Code (NEC), Table 300.5.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

110-3.4 Markers. The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet square and 4 - 6 inches thick extending approximately one inch above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the Engineer. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be 4 inches high and 3 inches wide with width of stroke 1/2 inch and 1/4 inch deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

110-3.5 Backfilling for conduits. For conduits, 8 inches (200 mm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 “Excavation and Embankment” except that material used for back fill shall be select material not larger than 4 inches (100 mm) in diameter.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

110-3.6 Backfilling for duct banks. After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for backfill shall be select material not larger than 4 inches (100 mm) in diameter. In addition to the requirements of P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet (76 m) of duct bank or one work period’s construction, whichever is less.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

110-3.7 Restoration. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall **be as** shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

METHOD OF MEASUREMENT

110-4.1 Underground conduits and duct banks shall be measured by the linear feet of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and for drain lines, the termination at the drainage structure, installed by directional bore method or open cut, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

BASIS OF PAYMENT

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110-5.1 1-way 2" Schedule 40 Pvc, Concrete Encased W/ Electrical Warning Tape – per linear foot

Item L-110-5.2 2-way 2" Schedule 40 Pvc, Concrete Encased W/ Electrical Warning Tape – per linear foot

MATERIAL REQUIREMENTS

Advisory Circular (AC) 150/5340-30J Design and Installation Details for Airport Visual Aids

AC 150/5345-53 Airport Lighting Equipment Certification Program

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories Standard 6
Electrical Rigid Metal Conduit - Steel

Underwriters Laboratories Standard 514B
Conduit, Tubing, and Cable Fittings

Underwriters Laboratories Standard 514C
Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

Underwriters Laboratories Standard 1242
Electrical Intermediate Metal Conduit Steel

Underwriters Laboratories Standard 651
Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

Underwriters Laboratories Standard 651A
Type EB and A Rigid PVC Conduit and HDPE Conduit

END OF ITEM L-110

SECTION L-110
INSTALLATION OF AIRPORT UNDERGROUND ELECTRICAL AND COMMUNICATIONS DUCTS

DESCRIPTION

110-1.1 The work under this Section consists of underground electrical and communications ducts and conduits installed in accordance with this technical specification at the locations and in accordance with the dimensions, designs, and details shown in the Plans, including all trenching, backfilling, removal and restoration of any paved areas, concrete encasement, counterpoise wire, mandrelling, installation of drag wires or lines, any duct markers, capping, and the testing of the installation as a completed duct system ready for installation of cables.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL. All equipment and materials shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Architect/Engineer.

110-2.2 RIGID METALLIC CONDUIT. Rigid metallic conduit and fittings shall be steel and shall conform to UL6, ANSI C-80.1, Federal Specification WW-C-581, and ASTM A618, grade I.

Rigid metallic conduit shall be fabricated from seamless corrosion resisting steel tubing with a wall thickness equal to Schedule 40 pipe (wall thickness of conduits shall be in accordance with ASTM A53). The conduit shall be hot-dipped galvanized inside and out, throughout its entire length including the threads. Minimum weight of galvanized coating shall be 1 ounce per square foot. The couplings supplied shall be hot-dipped galvanized.

110-2.3 RIGID NONMETALLIC CONDUIT. Rigid nonmetallic conduit shall be polyvinyl chloride (PVC) conduit and shall be made from virgin polyvinyl resins that conform to ASTM D 1784, Class 12454-B. The PVC conduit shall exceed all the property requirements including impact strength, chemical resistance, ultraviolet resistance, 90^{o}C heat resistance, and flammability as listed in UL 651 and NEMA TC 2. The rigid nonmetallic PVC conduit shall be Type II, Schedule 40 suitable for direct burial. Fittings shall also be made from high impact polyvinyl chloride; they shall be of the socket type and be joined to the conduit using polyvinyl chloride solvent cement. Fittings including couplings shall conform to NEMA TC 3.

Solvent cement used for joining PVC conduits and fittings shall be a heavy bodied cement complying with ASTM D 2564 and shall be applied with a natural bristle or nylon brush.

110-2.4 CONCRETE. Concrete shall conform to Section P-610, Structural Portland Cement Concrete, Class II using aggregate size No. 67 except that concrete backfill for trenches along and across active runways, taxiways and aprons shall be Class III or IV using Type III cement, aggregate size No. 8 and set accelerator admixture, all as directed or approved by the Architect/Engineer.

110-2.5 COPPER COUNTERPOISE WIRE. Counterpoise wire shall meet the requirements of Section L-108.

CONSTRUCTION METHODS

110-3.1 GENERAL. The Contractor shall install underground ducts at the approximate locations indicated on the Plans. The Architect/Engineer will indicate specific locations as the work progresses. Ducts shall be of the size, material, and type indicated in the Plans and Technical Specifications. Where no size is indicated in the Plans or the Technical Specifications, the ducts shall be not less than 3 inches *(75 mm)* inside diameter. All duct lines shall be laid so as to grade toward handholes, manholes and duct ends for drainage. Grades shall be at least 3 inches *(75 mm)* per 100 feet *(30 m)*. On runs where it is not practicable to maintain the grade all one way, the duct lines shall be graded from the center in both directions toward manholes, handholes, or duct ends. Pockets or traps where moisture may accumulate shall be avoided.

The Contractor shall mandrel each duct. An iron-shod mandrel, not more than 1/4-inch *(6 mm)* smaller than the bore of the duct shall be pushed through each duct by means of jointed conduit rods. The mandrel shall have a leather or rubber gasket slightly larger than the duct hole.

All ducts installed shall be provided with a No. 18 Nylon/Dacron line for pulling the permanent wiring. Sufficient length of pull line shall be left in manholes or handholes to prevent it from slipping back into the duct. Where spare ducts are installed, as indicated on the Plans, the open ends shall be plugged with removable tapered plugs, designed by the duct manufacturer, or with hardwood plugs conforming accurately to the shape of the duct and having the larger end of the plug at least 1/4-inch *(6 mm)* greater in diameter than the duct.

All ducts shall be securely fastened in place during construction and progress of the work and all the joints properly secured, and all ends plugged to prevent seepage of grout, water, or dirt. Any duct section having a defective joint shall not be installed.

Unless otherwise shown on the Plans, all ducts installed under runways, taxiways, aprons, and other paved areas shall be encased in a concrete envelope.

Where turf is well established and the sod can be removed, it shall be carefully stripped, properly stored and replaced at the completion of the work.

Trenches for ducts may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of road patrols or graders shall not be used to excavate the trench.

Existing cables, ducts and other articles shall be located prior to excavation and protected from damage throughout the construction process.

Perform all excavation and backfill in accordance with the applicable requirements of Sections P-701, P-152 and P-160.

110-3.2 DUCTS ENCASED IN CONCRETE. Unless otherwise shown in the Plans, concrete-encased ducts shall be installed so that the top of the concrete envelope is not less than 18 *(45 cm)* inches below the finished subgrade where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches *(45 cm)* below finished grade where installed in unpaved areas. Ducts under paved areas or blast protection pavement shall extend at least 3 feet *(90 cm)* beyond the edges of the pavement or 3 feet *(90 cm)* beyond any underdrains which may be installed alongside the paved area. Trenches for concrete-encased ducts shall be opened the complete length before installing ducts. The Architect/Engineer will direct any revisions required to circumvent obstructions encountered by the excavation. Concrete encasement of ducts shall be as shown on the Plans. Spacers shall be used to position ducts and to secure the ducts during concrete placement. End bells or couplings shall be installed flush with the concrete encasement where required.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric as shown on the Plans. The Contractor shall supply additional supports where the ground is soft and boggy where ducts cross under roadways, and where shown on the Plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings or piers, located at approximately 5-foot intervals.

110-3.3 DUCTS WITHOUT CONCRETE ENCASEMENT. Trenches for single-duct lines shall be not less than 6 inches *(0.5 cm)* nor more than 12 inches *(30 cm)* wide. Trench for 2 or more ducts installed at the same level shall be proportionately wider. Trench bottoms for ducts without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the duct along its entire length.

A layer of fine soil material, at least 4 inches *(100 mm)* thick (loose measurement) shall be placed in the bottom of the trench as bedding for the duct. The bedding material shall consist of soil, sand, or other fine fill, and it shall contain no particles that would be retained on a 1/4-inch *(6 mm)* sieve. The bedding material shall be tamped until firm.

Unless otherwise shown in Plans, ducts for direct burial shall be installed so that the tops of all ducts are at least 24 inches *(6 mm)* below the finished grade.

When two or more ducts are installed in the same trench without concrete encasement, they shall be spaced not less than 2 inches *(50 mm)* apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches *(15 cm)* apart in a vertical direction.

Trenches shall be opened the complete length before installing duct so that, if any obstructions are encountered, proper provisions can be made as directed by the Architect/Engineer to avoid them.

110-3.4 - DUCT MARKERS. The location of the ends of all ducts shall be marked by a concrete slab marker 2 feet *(60 cm)* square and 4 inches *(100 mm)* thick extending approximately 1 inch *(25 mm)* above the surface. The markers shall be located above the ends of all ducts or duct banks, except where ducts terminate in a handhole, manhole, or building.

The Contractor shall impress the word "duct" on each marker slab. He shall also impress on the slab the number and size of ducts beneath the marker. The letters shall be 4 inches *(100 mm)* high and 3 inches *(75 mm)* wide with width of stroke 1 1/2-inch *(12 mm)* and 1/4-inch *(6 mm)* deep or as large as the available space permits.

In lieu of duct markers, the Contractor shall, where so indicated on the Plans, mark the location of the free ends of all new or extended ducts, by painting the edge of pavement over the encased duct as shown on the Plans.

If the Contractor finds or uses an existing duct he shall install a duct marker or paint the edge of pavement over the free ends of the duct as shown on the Plans or as directed by the Architect/Engineer.

110-3.5 BACKFILLING. After concrete-encased ducts have been properly installed and the concrete has had time to set, and after the counterpoise wire has been installed and connected per Section L-108*,* the trench shall be backfilled with an approved granular material containing no particle larger than 4 inches *(100 mm)* in diameter. Backfill material shall be placed in layers not exceeding 8 inches *(20 cm)* in depth and compacted to at least the density of the surrounding undisturbed soil (not less than 96% under unpaved areas and not less than 100% under paved areas, in accordance with the requirements of MDAD Specification Section T-611). The backfill material shall be moistened or aerated as necessary to obtain required compaction.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled level with the adjacent surface or to bottom of subgrade.

Any excess excavated material shall be removed and disposed of in accordance with the requirements of Section P-152.

For ducts without concrete encasement, 8 inches *(20 cm)* of approved granular material (loose measurement) shall be placed around the ducts and carefully tamped around and over them with hand tampers. The remaining trench shall be backfilled and compacted as specified in the first paragraph of this Article.

110-3.6 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction and other work shall be restored to its original condition. The restoration shall include any necessary topsoiling, fertilizing, seeding and sprigging. All such work shall be performed in accordance with the Standard Turfing Specifications. The Contractor shall maintain all disturbed surfaces until final acceptance.

Restoration of paved surfaces shall be as shown on the Plans. A bituminous concrete 1/2 inch *(12.5 mm)* Nominal Max Mixture (leveling course) shall be placed and compacted as specified in Section P-401, except that hand methods of placement and compaction may be employed in inaccessible to paving equipment areas when so approved by the Architect-Engineer. Surface Density Tests shall be made at the direction of the Architect-Engineer.

110-3.7 EXTENSION OF EXISTING DUCTS. Existing ducts and duct banks that are to be extended under the proposed pavement shall be extended as shown on the Plans. Where cable, supplying active circuits, must be removed and relocated, the relocation work shall be done in close coordination with MDAD Airport Operations through the Architect/Engineer.

110-3.8 REPAIR DAMAGED GALVANIZING. Damaged galvanized surfaces shall be repaired in accordance with requirements of ASTM A780, Annexes A1 or A3, all subject to approval by the Architect/Engineer. The use of zinc-rich paints will not be acceptable. Thickness of the applied zinc repair compounds shall be not less the thickness of the existing zinc coating; check the thickness of the repaired surfaces using either a magnetic or electromagnetic gage.

METHOD OF MEASUREMENT

110-4.1 Measurement of underground steel conduit and duct (in trench or concrete encased), for payment shall be the number of linear (feet) *(meters)* of steel conduit and duct installed (in trench or concrete encased), measured in place, complete and accepted in accordance with the Plans and these Technical Specifications. Separate measurement shall be made for each of the various types and sizes of conduits or ducts.

BASIS OF PAYMENT

110-5.1 Payment for the quantities measured as described in Article 110-4.1 shall be made at the Contract Unit Price Bid per Linear (Foot) *(Meter)*, for steel conduit, for concrete encased duct, for duct in trench and for concrete encased split duct of the sizes specified, which prices and payment shall be full compensation for furnishing all labor, materials, including excavation, backfilling, equipment, processes, tools and any incidentals necessary to complete the work covered by this Section.

Payment for counterpoise wire will be made under Section L-108.

Payment shall be made under:

Item No.	-	(--way)(size) Steel Conduit, in Trench	Per Linear (Foot) *(Meter)*
Item No.	-	(--way)(size) PVC Duct, Concrete Encased	Per Linear (Foot) *(Meter)*
Item No.	-	(--way)(size) PVC Duct, in Trench	Per Linear (Foot) *(Meter)*
Item No.	-	(--way)(size) PVC Split Duct, Concrete Encased	Per Linear (Foot) *(Meter)*

SPECIFICATIONS REFERENCED IN ITEM L-110

Number	Title
FS.WW-C-581	Conduit, Metal, Rigid; and Coupling, Elbow; and Nipple, Electrical Conduit: Zinc-Coated.
ANSI C 80.1	Conduit, Steel Rigid
NEMA TC-2	Conduits, PVC
NEMA TC-3	Fittings, PVC
ASTM A 53	Pipe, Steel
ASTM A 618	Tubing, Steel
ASTM A 780	Galvanizing, Repair
ASTM D 1785	Conduit, Rigid Non-Metallic (PVC)
ASTM D 2564	Adhesives
MDAD T-611	Compaction Control and Limerock Testing
MDAD P-152	Excavation and Embankment
MDAD P-160	Contaminated Soils / Groundwater
MDAD P-610	Structural Portland Cement Concrete
MDAD L-108	Installation of Underground Cable For Airports

CHECKLIST FOR UNDERGROUND DUCT

1. ______ Is the material, size and number of ducts in accordance with contract plans and specifications?

2. ______ Is minimum depth to top of ducts 18" or 24" for direct burial as required?

3. ______ Are ducts sloped toward manholes and without low spots and pockets?

4. ______ Are ends of spare ducts plugged with removable tapered plugs before burying underground?

5. ______ Are all directly buried rigid steel conduits being given a coat of coal tar paint and are they thoroughly dried before backfilling?

6. ______ Are ground bushings installed on each end of underground steel conduits and are ground bushings connected to the counterpoise?

7. ______ Are ducts being mandrelled just prior to pulling of cables?

8. ______ Is a nylon/dacron rope being installed in all ducts for pulling of cables?

9. ______ Is sufficient length of pull rope being left in handholes and manholes?

10. ______ Are ducts securely fastened in place during construction and are all joints watertight and without defects?

11. ______ Are trenches for encased ducts opened the entire length so as to avoid obstruction?

12. ______ Is a minimum of 3" *(75 mm)* of concrete placed around encased ducts?

13. ______ Has concrete had time to set before backfilling over concrete encased ducts?

14. ______ Has counterpoise wire been properly installed over duct or cables and connected to ground rods, light fixture bases and mounting stakes before backfilling, per Section L-108?

15. ______ Are trenches for concrete encased ducts backfilled with excavated material no larger than 4" *(100mm)* in diameter, and is the material placed in at least 12inch *(30 cm)* layers and thoroughly tamped and compacted after each layer?

16. ______ Are trenches free from pools of water and not excessively wet during backfilling operations?

17. ______ Is excess excavated material removed and stockpiled onsite to satisfaction of airport sponsor?

CHECKLIST FOR UNDERGROUND DUCT - CONTINUED

18. ______ Where sod has been removed for trenching, has the sod been replaced as soon as possible after backfilling operations?

19. ______ Has area disturbed by trenching, storing of dirt, cable laying, pad construction, and other work been restored to satisfaction of airport sponsor?

20. ______ Are ends of all ducts that are not terminated at handholes or manholes marked with painted markings on the edge of pavements?

21. ______ Are home run duct markers of proper size and are they securely and otherwise properly installed?

22. ______ Are the markings on duct markers correct and neatly inscribed or painted on pavement edge as required?

END OF SECTION

ITEM L-115
ELECTRICAL MANHOLES AND JUNCTION STRUCTURES

DESCRIPTION

115-1.1 This item shall consist of electrical manholes and junction structures (handholes, pullboxes, junction cans, etc.) installed in accordance with this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the Engineer. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

115-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

115-2.2 CONCRETE STRUCTURES. Cast-in-place concrete structures shall conform to the details and dimensions shown on the plans.

Provide precast concrete structures where shown on the plans. Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand loads as detailed in AC 150-5320-6 Appendix 3, most recent edition, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the Engineer shall be submitted by the Contractor to allow for a full evaluation by the Engineer. The Engineer shall review in accordance with the process defined in the General Provisions.

115-2.3 JUNCTION CANS. Junction Cans shall be L-867 Class 1 (non-load bearing) encased in concrete. The cans shall have a galvanized steel blank cover, gasket, and stainless steel hardware. Covers shall be 3/8" thickness for L-867 and 3/4" thickness for L-868.

115-2.4 MORTAR. The mortar shall be composed of one part of portland cement and two parts of mortar sand, by volume. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15 percent of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C 6. The water shall be clean and free of deleterious amounts of acid, alkalies or organic material. If the water is of questionable quality, it shall be tested in accordance with AASHTO T-26.

115-2.5 CONCRETE. All concrete used in structures shall conform to the requirements of Item P-610, Structural Portland Cement Concrete.

115-2.6 FRAMES AND COVERS. The frames shall conform to one of the following requirements:

a. Gray iron castings shall meet the requirements of ASTM A 48.

b. Malleable iron castings shall meet the requirements of ASTM A 47.

c. Steel castings shall meet the requirements of ASTM A 27.

d. Structural steel for frames shall conform to the requirements of ASTM A-283, Grade D.

e. Ductile iron castings shall conform to the requirements of ASTM A 536.

f. Austempered ductile iron castings shall conform to the requirements of ASTM A 897.

All castings specified shall withstand a maximum tire pressure of **250 psi** and maximum load of **100,000 pounds**.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A 123.

Each cover shall have an approved designation cast on it. “FPL” shall be used for Florida Power and Light manhole covers. “COMM” shall be used for MDAD communications manhole covers.

115-2.7 LADDERS. Ladders, if specified, shall be galvanized steel or as shown on the plans.

115-2.8 REINFORCING STEEL. All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A 615, Grade 60.

115-2.9 BEDDING/SPECIAL BACKFILL. Bedding or special backfill shall be as shown on the plans.

115-2.10 FLOWABLE BACKFILL. Flowable material used to backfill shall conform to the requirements of Item P-153 "Controlled Low Strength Material".

115-2.11 CABLE TRAYS. Cable trays shall be of galvanized steel, plastic, or aluminum. Cable trays shall be located as shown on the plans.

115-2.12 PLASTIC CONDUIT. Plastic conduit shall comply with Item L-110 **-** Airport Underground Electrical Duct Banks and Conduits.

115-2.13 CONDUIT TERMINATORS. Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

115-2.14 PULLING-IN IRONS. Pulling-in irons shall be manufactured with 7/8-inch (22mm) diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch diameter with an ultimate strength of 270,000 psi). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115-2.15 GROUND RODS. Ground rods shall be one piece, **10 mils copper bonded steel.** The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 10-feet long nor less than 3/4 inch in diameter.

CONSTRUCTION METHODS

115-3.1 UNCLASSIFIED EXCAVATION. It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the Engineer without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to the respective L-115 pay item of which it is a component part. Dewatering necessary for L-115 structure installation, erosion and turbidity control, in accordance with Federal, State, and Local requirements is incidental to its respective pay item as a part of Item L-115. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-115 Item.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the Engineer. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the Engineer. Structures shall be placed after the Engineer has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches of sand or a material approved by the Engineer as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

115-3.2 CONCRETE STRUCTURES. Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is placed.

115-3.3 PRECAST UNIT INSTALLATIONS. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS. All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the Engineer and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written permission is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115-3.5 INSTALLATION OF LADDERS. Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

115-3.6 REMOVAL OF SHEETING AND BRACING. In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than six (6) inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The Engineer may order the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.7 BACKFILLING. After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.

Backfill shall not be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the Engineer may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115-3.8 CONNECTION OF DUCT BANKS. To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115-3.9 CLEANUP AND REPAIR. After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound conforming MIL-P-21035. Surfaces shall be prepared and compound applied in accordance with manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115-3.10 RESTORATION. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

115-3.11 INSPECTION. Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested utilizing the fall-of-potential ground impedance test as described by ANSI IEEE Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115-3.12 Duct Extension to Existing Ducts. Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

METHOD OF MEASUREMENT

115-4.1 Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following additional items are specifically included in each unit.

- All Required Excavation, Dewatering
- Sheeting and Bracing
- All Required Backfilling with On-Site Materials
- Restoration of All Surfaces and Finished Grading, Sodding
- All Required Connections
- Dewatering If Required
- Temporary Cables and Connections
- Ground Rod Testing

BASIS OF PAYMENT

115-5.1 The accepted quantity of electrical junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

115-5.2 Payment shall be made at the contract unit price for junction can elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the plans and to the satisfaction of the Engineer.

Payment will be made under:

Item L-115-5.1	L-867 12-inch Diameter Junction Can with Blank Cover Installed in Earth/New Shoulder Pavement - Per Each

MATERIAL REQUIREMENTS

ANSI/IEEE Std 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle Cable Connectors
FED SPEC J-C-30	Cable and Wire, Electrical Power, Fixed Installation (cancelled; replaced by AA-59544 Cable and Wire, Electrical (Power, Fixed Installation))
ASTM B.3	Soft or Annealed Copper Wire
ASTM B.8	Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard, or Soft

END OF ITEM L-115

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ITEM L-125S
INSTALLATION OF AIRPORT LIGHTING SYSTEMS
SUPPLEMENT

DELETE the entire specification and **INSERT** the following**:**

DESCRIPTION

125-1.1 This item shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable advisory circulars. The systems are installed at the locations and in accordance with the dimensions, design, and details shown in the plans. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

125-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be as approved under the Airport Lighting Equipment Certification Program described in the current version of Appendix 3 to Advisory Circular (AC) 150/5345-53.

b. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications, Appendix 3 to AC 150/5345-53 and as deemed acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The submitted data shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications and AC 150/5345-53. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least [twelve (12) months] from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

EQUIPMENT AND MATERIALS

125-2.2 CONCRETE. Concrete shall conform to Specification Item P610 Structural Portland Cement Concrete.

125-2.3 CONDUIT. Conduit shall conform to Specification Item L-110 Installation of Airport Underground Electrical Duct.

125-2.4 CABLE AND COUNTERPOISE. Cable and Counterpoise shall conform to Item L-108 Installation of Underground Cable for Airports.

125-2.5 TAPE. Rubber electrical tape shall be a self-fusing Ethylene Propylene Rubber (EPR) based high-insulating voltage tape such Scotch Electrical Tape Number 23 as manufactured by 3M Company or an approved equal.

Plastic vinyl tape shall be 8.5 mil heavy duty, premium grade all-weather vinyl electrical insulating tape such as Scotch Premium Vinyl Electrical Tape 88 as manufactured by 3M Company or an approved equal.

125-2.6 CABLE CONNECTIONS. Cable Connections shall conform to Item L-108 Installation of Underground Cable for Airports.

125-2.7 LIGHT BASE AND TRANSFORMER HOUSINGS. Light Base and Transformer Housings shall conform to the requirements of 150/5345-42 and be listed in appendix 3 to AC 150/5345-53. Light bases shall be Type L-867 or L-868, Class 1A, Size B (or as shown on the plans) shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures.

125-2.8 ISOLATION TRANSFORMERS. Isolation transformers shall be Type L-830, size as required for each installation. Transformer shall conform to AC 150/5345-47 and be listed in appendix 3 to AC 150/5345-53.

125-2.10 RUNWAY EDGE AND TAXIWAY LIGHTS. Edge Lights shall conform to the requirements of 150/5345-46 and be listed in appendix 3 to AC 150/5345-53. ADBSafegate is the basis of design for airfield lighting equipment.

a. **Runway Elevated Edge Lights.**
L-862(L) Runway Edge Lights, color white/white and white/yellow, maximum 45w fixture load.

b. Taxiway Elevated Lights.
L-861T(L) Taxiway Edge Light, LED, 14 inches in height, blue in color (even when not energized), maximum 20 VA fixture load with no heater.

d. Lamps and Filters
Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract.

Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

CONSTRUCTION

125-3.1 SHIPPING AND STORAGE

a. Equipment should be shipped in suitable packing material to prevent damage during shipping. Equipment and materials should be maintained in new condition and stored in areas protected from weather and physical damage.

b. Any equipment and materials, in the opinion of the Engineer, damaged during construction or storage shall be replaced by the contractor at no additional cost to the owner. Painted or galvanized surfaces that are damaged shall be repaired according to manufacturers recommendations.

125-3.2 ELEVATED LIGHTS

a. Water, debris, and other foreign substances shall be removed prior to installing light base and light.

b. A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixture shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. Outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

METHOD OF MEASUREMENT

125-4.1 Existing Runway and Taxiway lights that are being disconnected and stored for re-installation shall be paid for by each and shall include all items as necessary to properly protect and store the fixtures.

125-4.2 Existing Runway and Taxiway lights that are being re-used shall be paid for by installation of each fixture. Each unit shall include new transformer, splice kits, miscellaneous hardware and all required for complete operation and accepted by Engineer.

125-4.3 L-862(L) Led Runway Edge Light shall be paid for by each. This shall include all equipment required for a complete fixture including base can, transformer, splice kits, base can covers, miscellaneous hardware, and all required for complete operation and accepted by Engineer.

125-4.4 L-861T(L) Led Taxiway Edge Light shall be paid for by each. This shall include all equipment required for a complete fixture including base can, transformer, splice kits, base can covers, miscellaneous hardware, and all required for complete operation and accepted by Engineer.

125-4.5 L-850D(L) led inground edge/threshold aircraft rated light shall be paid for by each. This shall include all equipment required for a complete fixture including base can, transformer, splice kits, base can covers, miscellaneous hardware, and all required for complete operation and accepted by Engineer.

125-4.6 L-867 12-inch diameter base can for edge lights shall be paid for by each. This shall include all accessories required for the base cans for re-used and new elevated light fixtures, base can cover, and installation for a complete and structurally sound base.

125-4.7 L-868B aircraft rated 12-inch diameter base can with cover shall be paid for by each. This shall include all accessories required for base cans for inground light fixtures, base can cover and installations for a complete and structurally sound base.

125-4.8 L-868D aircraft rated 16-inch diameter base can with cover shall be paid for by each. This shall include all accessories required for base cans for inground light fixtures, base can cover and installations for a complete and structurally sound base.

125-4.9 Existing sign temporary removal, storage, and re-installation shall be paid for by each and shall include all items as required for a complete re-connection of existing signage. This item includes all labor, equipment, materials, tools, site preparation, assembly and installation.

BASIS OF PAYMENT

125-5.1 Payment will be made at the Contract unit price for each complete taxiway light installed by the Contractor and accepted by the Engineer. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

Item L-125-5.1	L-862(L) Led Runway or L-861T(L) Taxiway Edge Light, (Disconnect existing fixture, Remove, and Store)	per each
Item L-125-5.2	L-862(L) Led runway or l-861T(L) led taxiway edge light, (install previously stored fixture onto new base can - includes transformer, and splice kits. Base can is under separate line item)	per each
Item L-125-5.3	L-862(L) led runway edge light, new complete fixture which includes base can, transformer, splice kits, light fixture and installation.	per each
Item L-125-5.4	L-861T(L) led taxiway edge light, new complete fixture which includes base can, transformer, splice kits, light fixture and installation.	per each
Item L-125-5.5	L-850D(L) led inground edge/threshold aircraft rated light new fixture which includes base can, transformer, splice kits, light fixture, base can cover and installation.	per each
Item L-125-5.6	L-867 12-inch diameter base can for edge lights with cover, installed in earth / shoulder	per each
Item L-125-5.7	L-868B aircraft rated 12-inch diameter base can with cover, installed in earth/new shoulder pavement	per each
Item L-125-5.8	L-868D aircraft rated 16-inch diameter base can with cover and new concrete base (for relocated signs)	per each
Item L-125-5.9	Existing sign removed during grading, stored, and re-installed	per each

MATERIAL REQUIREMENTS

AC 150/5345-5	Circuit Selector Switch
AC 150/5345-26	L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-42	Airport Light Bases, Transformer Houses, Junction Boxes and Accessories
AC 150/5345-46	Runway and Taxiway Light Fixtures
AC 150/5345-47	Isolation Transformers for Airport Lighting Systems

END OF ITEM L-125

L-125 INSTALLATION OF AIRPORT LIGHTING SYSTEMS

DESCRIPTION

125-1.1 This Section shall consist of furnishing and installing airport lighting systems in accordance with this Technical Specification, the referenced FAA Specification, and the applicable FAA Advisory Circulars. The systems are installed at the location and in accordance with the dimensions, design, and details shown in the Plans. This Section shall include the furnishing of all equipment, materials, services, performance of all work, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the Architect/Engineer.

125-1.2 Additional details pertaining to a specific system covered in this Section are contained in the current issue of the Advisory Circulars in referenced paragraphs 125-1.3 through 125-1.11.

125-1.3 AC 150/5340-4, Installation Details for Runway Centerline and Touchdown Zone Lighting Systems.

125-1.4 AC 150/5340-14, Economy Approach Lighting Aids.

125-1.5 AC 150/5340-16, Medium Intensity Runway Lighting System.

125-1.6 AC 150/5340-18, Standards for Airport Sign Systems.

125-1.7 AC 150/5340-19, Taxiway Centerline Lighting System.

125-1.8 AC 150/5340-21, Airport Miscellaneous Lighting Visual Aids.

125-1.9 AC 150/5340-24, Runway and Taxiway Edge Lighting System.

125-1.10 AC 150/5340-25, Visual Approach Slope Indicator (VASI) Systems.

125-1.11 AC 150/5345-1, Approved Airport Lighting Equipment.

125-1.12 AC 150/5345-46A Runway and Taxiway Light Fixtures.

125-1.13 AC 150/5345-47 Isolation Transformers for Airport Lighting Systems.

The Contractor shall procure and have available for use on the job site at all times at least one copy of the Advisory Circulars issued by the Federal Aviation Administration referenced to herein.

EQUIPMENT AND MATERIALS

125-2.1 GENERAL

(a) Airport Lighting equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Administration, Airports Service, Washington, D.C. 20591, and shall be listed in the current Advisory Circular 150/5345-1, Approved Airport Lighting Equipment.

(b) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through the manufacturer's certification of compliance with the applicable specifications.

(c) Lists of equipment and materials required for a particular system are contained in the applicable FAA Advisory Circulars.

"Wherever reference is made in any item to prior approval of equipment and materials covered by FAA Specifications as listed in "Approved Airport Lighting Equipment", the publication is identified as Advisory Circular No. 150/5345-1, current issue. This publication contains a current listing of L-800 series specifications together with their advisory circular number when appropriate. This FAA Advisory Circular should be used, when needed, as a cross reference to identify the specific L-800 series specifications with the assigned FAA Advisory Circular number."

125-2.2 TAPE Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88, respectively, as manufactured by the Minnesota Mining and Manufacturing Company, or an approved equal.

125-2.3 CONCRETE Concrete for backfill shall conform to the requirements of DCAD Standard Technical Specification Section P-610 Structural Portland Cement Concrete Class II, using FDOT Grade #89 Coarse Aggregate.

125-2.4 CONDUIT Rigid steel conduit and fitting shall conform to the requirements of the requirements of DCAD Standard Technical Specification Section L-110.

125-2.5 SQUEEZE CONNECTORS Connectors shall be either the field-attached or factory-molded plug-in L-823 as specified in DCAD Standard Technical Specification Section L-108.

125-2.6 TEES Large radius bend tees, if specified, shall be equal to Crouse-Hinds Company No. ET-43.

CONSTRUCTION METHODS

125-3.1 GENERAL The installation and testing details for the systems shall be as specified in the applicable FAA Advisory Circulars.

125-3.2 PLACING LIGHTS Light fixtures shall be installed at the locations designated by coordinates shown on the Plans; the Contractor shall employ the services of a registered surveyor to layout and certify as to locations and elevations and that the light bases are installed in accordance with the plans, and to locate fixture bases after pavement is completed.

125-3.3 REPAIR DAMAGED GALVANIZING Damaged galvanized surfaces shall be repaired in accordance with requirements of ASTM A780, Annexes A1 or A3, all subject to approval by the Architect/Engineer. The use of zinc-rich paints will not be acceptable. Thickness of the applied zinc repair compound shall be not less the thickness of the existing zinc coating; check the thickness of the repaired surfaces using either a magnetic or electromagnetic gage.

METHOD OF MEASUREMENT

125-4.1 The quantity of light fixtures, and other bid items to be paid for under this Section shall be the number of each type light fixture, or other bid items, as designated in the Plans as a unit, installed as completed units in place, ready for operation, and accepted by the Architect/Engineer.

BASIS OF PAYMENT

125-5.1 Payment will be made at the Contract Unit Price Bid for each complete light fixture, or other Bid Items, as designated in the plans as a unit, installed in place and accepted by the Architect/Engineer. This price shall be full compensation for furnishing all materials, and for all labor, work, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

Item L-125-5.1	Medium Intensity Runway Lights, Base Mounted in Place--per each.
Item L-125-5.1	Taxiway Lights, Base Mounted in Place --per each.
Item L-125-5.1	Medium Intensity Runway Lights, Stake Mounted in Place--per each.
Item L-125-5.1	Taxiway Lights, Stake Mounted in Place--per each.
Item L-125-5.1	High Intensity Runway Lights, in Place--per each.
Item L-125-5.1	Touchdown Zone Lights in Place--per each.

Item L-125-5.1	Runway Centerline Lights, in P-lace--per each.
Item L-125-5.1	Medium Intensity Approach Lights, in Place--per each.
Item L-125-5.1	Runway End Identification Lights, in Place--per each.
Item L-125-5.1	Abbreviated Visual Approach Slope Indicator, in Place--per each.
Item L-125-5.1	Airport Taxi Guidance Signs, in P-lace--per unit of like size.

END OF SECTION

CHECKLIST FOR RUNWAY AND TAXIWAY EDGE LIGHTING SYSTEMS

1. ________ Has all installed equipment and material of the FAA L-800 series been approved by the consulting engineer and is it listed in the latest issue of AC 150/5345-1?

2. ________ Are the tops of metal stakes for stake mounted fixtures flush with grade, and do stakes have concrete anchors at bottom?

3. __________ Are the light locations, spacings, and numbering of lights in accordance with plans?

4. ________ Are the lights plumb and are their heads tight and level?

5. ________ Are the heights of all lights the same elevation above the runway edge and at a maximum height of 14" above ground level?

6. ________ Are the lights in line, at proper distance from Edge of pavement, and have they been viewed at night and are the lenses properly oriented?

7. ________ Are all the lamps of proper wattage?

8. ___________ Are the threshold light lenses red/green; are they properly oriented; are the lights at same elevation; and are the lights properly spaced and at correct distance from end of runway?

9. ________ Are other lenses of runway and taxiway lights of proper color?

10. ________ Is grading around lights acceptable and is there a smooth transition between concrete envelopes around base cans and the surrounding grade?

11. ________ Are all the lights operating?

12. ________ Are L-823 connectors of proper size and do they fit the cable; are all connector joints wrapped with a heat shrinkable sleeve?

13. ________ Do all elevated lights have breakable couplings installed at base of supporting tubing?

14. ________ Are tops of base cans slightly above surrounding grade to keep water from the covers?

15. ________ Has a minimum of 4" of concrete been poured around all base mounted cans?

16. ________ Are base cover gaskets properly installed; are cover screws made of stainless steel and are they properly tightened?

17. _________ Are all lights properly marked with tag or properly inscribed on concrete for base mounted lights in accordance to details and numbering system on lighting layout plan?

CHECKLIST FOR TAXI GUIDANCE SIGNS

1. ________ Is all installed equipment and material new and that covered by FAA L-800 series listed in the latest issue of AC 150/5345-1?

2. ________ Are the L-823 connectors of proper size and do they properly fit the cable?

3. ________ Are all connector joints wrapped with a heat shrinkable sleeve?

4. ________ Are the tops of the metal stakes, where specified, flush with the grade?

5. ________ Have breakable couplings been installed where shown on plans?

6. ________ Are all sign locations in accordance with the plans?

7. ________ Are types of signs (L-829 or L-858) shown on Plans?

8. __________ Is the size of numerals, method of numbering, color etc. in accordance with the plans and specifications?

9. ________ Are the signs properly mounted and aimed as shown on plans, and are their mounts tight?

10. ________ Is the height of all signs in accordance with the plans?

11. ________ Are the signs at proper distance from the pavements?

12. ________ Are all the lamps of proper wattage?

13. _________ Are the isolation transformers of proper size for the number of panels and type of signs used?

14. ________ Are the tops of the bases slightly above the surrounding grade in order to keep rain water away from the covers?

15. _________ Is there a smooth transition between the isolation transformer housing concrete envelopes and the surrounding grade?

16. ________ Are the base cover gaskets properly installed, are cover screws made of stainless steel and are they properly tightened?

17. ________ Are the letters, numerals, and symbols in accordance with the plans?

18. ________ Are signs connected to proper circuit as shown on the plans?

19. ________ Are all the new signs operating?

END OF SECTION

ITEM L-126 ELECTRICAL LINE DISTRIBUTION SYSTEMS (FAA OWNED)

DESCRIPTION

126-1.1 GENERAL

This section shall consist of work specific to FAA owned approach lighting systems. This section covers Electrical Line Distribution (ELD) systems, and non ELD infrastructure supporting the approach lighting aids. The scope of work is detailed within the N series of the project drawings.

The ELD systems, also known as supporting infrastructure, are unique to the FAA owned approach lighting aids. The ELD systems consist of handholes, conduit, duct markers, surge protection, wiring and counterpoise (guard) wiring. The ELD system installation specific items address surveying, trenching, backfilling, material installation, system identification and testing and reporting. The ELD system is associated with the exterior, power supply of FAA facilities.

Items within this specification shall be installed to FAA specifications. Refer to section 126-6.1 for additional references/criteria the contractor shall comply with. Specifications L-108, L-110 L-115 and L-125 shall not be applied to the approach lighting aids unless otherwise noted.

This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the Engineer. This item shall also include removal and disposal of all equipment and materials as shown on the Plans. Excavation and backfill required for installation of new approach lighting aids handholes and conduit ductbanks is incidental to this work.

Coordinate removal and installation of system components with FAA through the Engineer.

Verification of existing conditions such as locating, potholing, tracing coordination with FAA, local utilities and others deemed necessary shall be incidental to the pay items provided in this specification.

126-1.2 FAA SPECIFICATIONS AND OTHER PROJECT STANDARDS

Unless otherwise indicated, the contractor shall comply with the following FAA specifications and standards:

1. FAA-C-1217 (Latest Edition) Electrical Work, Interior
2. FAA-C-1391 (Latest Edition) Installation and Splicing of Underground Cables
3. FAA-STD-019 (Latest Edition) Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment.
4. NFPA No. 70 National Electrical Code
5. NFPA No. 780 Lightning Protection Code

126-1.3 INTERRUPTION OF POWER / NAS SERVICES

Contractor is advised that the project site is a fully operational NAS facility that supports the airport and/or the NAS. An un-scheduled power interruption to any of the electrical distribution systems or an interruption of the communication systems is not allowed. Work requiring a temporary or permanent de-energizing of the electrical service shall be scheduled and approved in writing by the Resident Engineer at least 14 calendar days in advance of performance of the work. Work may not commence until written authorization is received from the Resident Engineer.

126-1.4 CONTRACTOR QUALIFICATIONS

Work shall be performed by a contractor licensed in the State of Florida, with a minimum of five years of electrical contracting experience in airfield electrical systems and experience with NAVAIDS / FAA Orders. Refer to Division 1 for required 'Contractor Qualifications Statement' that must be provided at time of bid addressing additional requirements.

EQUIPMENT AND MATERIALS

126-2.1 GENERAL

The Contractor shall furnish all material, equipment and incidentals as required for a complete installation as shown on the plans, unless identified as "FAA Furnished" or "GFE". Unless otherwise shown, material and equipment shall be new and must comply with all contract documents and requirements. All material and equipment furnished by the Contractor shall be the standard products of manufacturers regularly engaged in the production of such material and be of the manufacturer's latest designs.

Wherever Underwriters' Laboratories, Inc. has established standards for a Contractor furnished item, that item shall bear the UL label. For items where UL standards are not established, the Contractor shall obtain listing or labeling from an agency acceptable to the authority having jurisdiction.

Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications, Appendix 3 to AC 150/5345-53 and as deemed acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

The rules, regulations and referenced specifications shall be considered as minimum requirements. These minimum requirements shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship than specified or when so required by the construction drawings.

126-2.2 EQUIPMENT SUBMITTALS

All materials and equipment used to construct these items shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise, and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with colored arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

The submitted data shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans, specifications and relevant FAA Advisory Circulars, and FAA Standards. The Contractor's submittals shall be organized in digital format (PDF). The Engineer reserves the right to reject any and all equipment, materials, or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

126-2.3 WARRANTY

All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

The FAA will take ownership of the approach aids, from the Airport, at conclusion of the project. The warranty shall be transferable to the FAA.

126-2.4 FAA DEFINED ELD SYSTEM / EQUIPMENT

Material Specifications for all ELD system below are detailed within the Reference to this speciation (Item 126-6.1). Abbreviated specification, application on the project and additional requirements beyond the reference is listed below for each ELD item.

1. Ridged Metal Conduit (Galvanized) – used for all above ground conduits at distribution racks. Comply with ANSI C80.3 and UL 797. Use where EMT is not specified.
2. PVC Coated RGS Conduit – used within foundations and within 10' of EES cables. Material: Coating Thickness: 0.040 inch, minimum. Comply with NEMA RN 1,
3. Direct Buried Ridged non-Metallic Conduit – PVC Schedule 80, used outside of EES loops. Additionally, PVC conduit shall be used for lighting down conductor connections within foundations. Comply with UL 651.
4. Duct Spacers – See Details. 6" min vertical clearance, 3" horizontal clearance.
5. Duct Hold Down Systems – See Details.
6. Pull Wires and Tape (pull strings) – Provided at all spare conduits. ¼" pull tape or nylon jet line having a minimum tensile strength of 210 pounds for non-metallic conduit. Comply with FAA-STD-019 Item 4.17.
7. Underground Duct and Cable Warning Tape - Furnish detectable underground warning tape for underground duct banks. Use aluminum backed, 0.005-inch thick, underground warning tape with a red background color. Lettering shall be black and indicate the type of service buried below: "CAUTION BURIED ELECTRIC LINE BELOW". Use tape width appropriate for the burial depth: A. Three-inch wide tape for up to 18 inches depth. B. Six-inch wide tape for up to 24 inches depth. Comply with FAA-STD-019 Item 4.16.
8. Insulated Bushings - NRTL-listed, malleable iron. Comply with FAA-C-1391 Item 4.10.
9. Grounding Bushings – Comply with FAA-STD-019 Item 4.5.4, FAA-STD-019 Items 4.11 and 5.5.5.3 and FAA-C-1217 Item 5.5.1.1.

10. Ground Rods. Ground rods shall be copper or copper clad steel, a minimum of 10 feet long and 3/4-inch diameter. Rod cladding shall not be less than 1/100 in. thick. Comply with FAA-STD-019 Item 4.4.4.1, FAA-C-1391 Item 4.20 and FAA-C-1217 Item 5.5.1.1.
11. Wire Gutters – 4” min size. Comply with FAA-C1391 Item 4.5.
12. Distribution Rack Foundations: Material: Concrete shall meet or exceed a 28-day compressive strength of 4,000 psi. Construction: chamfered 1”, brushed and graded for drainage.
13. Distribution Rack Post Supports– Material: 2” RGS. Construction: Install on frangible couplings on floor flanges, install with anchors,
14. Distribution Rack Channel / Strut– Material: Stainless Steel Type 304. UV Resistant plastic end caps. Install at all ends of strut material.
15. Floor Flanges – Material: Stainless. 6” OD with 2 11-1/2 npsm threaded, four 0.63” dia holes on 4.75” bolt pattern. applying asphaltic sealing compound on bottom of floor flange before placement and securing with anchors.
16. Frangible Couplings - Comply with FAA AC 150/5220-23 and FAA AC 150/5340-26. Frangible point shall be approximately 1” above pavement and not exceed 3” from ground level.
17. Lighting Protection Air Terminals at Distribution Rack - Comply with FAA-STD-019 item 4.3 (specifically 4.3.3 and 4.3.6).
18. Lighting Protection Down Conductor at Distribution Rack – Harger 28R or similar. Construction: end exothermic welds to the EES. Comply with FAA-STD-019 item 4.3 (specifically 4.3.5).
19. Lighting Protection Hardware at Distribution Rack – Comply with FAA-STD-019 item 4.3 (specifically 4.3.7).
20. Aircraft Rated Handhole Structure – Construction: Shall meet A/C 150-5320-6 for 250 psi (tire pressure and 100,000 lbs. (aircraft rated). Refer to plan details for additional specifics of handhole systems.
21. Aircraft Rated Handhole Lids / Covers – Provide Spring Assist Type with Safety Bar. Lids/Covers shall be marked as shown on plan details.
22. Handhole Accessories – Supports, Cable Racking Systems/ Arms /Insulators. Material: Non-conductive type. Refer to plan details.
23. Handhole Accessories - Ground Bus Plate – Refer to plan details.
24. Exterior Equipment Identification Tag / Labels - Materials. Shall be engraved phenolic type with black letters on white background. Use 3/8” letters for identifying individual equipment and loads.
25. Exterior Cable Identification - Refer to plan details.
26. Duct markers – Refer to plan details.
27. Arc Flash Labels – Suitable for exterior locations. Comply with FAA Order 6950.27A Power Systems Analyses Assessment.
28. Surge Protective Devices – Material: Provide stainless steel enclosure. Provide visual indicator of fault conditions on exterior of enclosure. See details for equipment details.

29. Service Disconnecting Means (SDM): Material: Stainless Steel. Type: Heavy Duty. Comply with FAA-C-1391 Item 4.5 & 5.10.

126-2.5 NON-FAA DEFINED ELD SYSTEMS / EQUIPMENT

1. Electrical Metallic Tubing (EMT) – used only at frangible connections per EB 79. Typically used for Legs of Approach Aids within the RSA above frangible points. Comply with ANSI C80.3 and UL 797.
2. Anchor / Wedge Bolts – Material: Stainless Steel. Epoxy methods acceptable alternative to wedge type.
3. Condulet Bodies - Material: Malleable iron body hot dip galvanized, stainless steel cover, neoprene gasket, stainless screws hardware. Type: Threaded. Comply with UL 514B.
4. Break Away Power Connectors – See Details.
5. Break Away Comm Connectors – See Details.
6. Threaded Reducing Bushings – Stainless Steel with RTV applied.
7. Flexible Metallic Liquid Type Conduit – Comply with UL 360.
8. Flexible Metallic Liquid Tight Conduit Connector – See Details.
9. Junction Cans (Light Bases / Transformer Housings) – L-867 / L-868 type, four 2” threaded hubs around the perimeter of the base 90 degrees apart, unless detailed on plans differently. Comply with AC 150/5345-42.
10. Splice Can Covers –L-867 Type 3/8” thick, fully installed above concrete, not imbedded.
11. RTV Silicone – Momentive RTV118 or similar.
12. Anti-Seize Compound – Non-Metal Based. Henkel Loctite® LB 8009 or LB 8023.
13. Rubber Electrical Tape - self-fusing Ethylene Propylene Rubber (EPR) based high-insulating voltage tape such Scotch Electrical Tape Number 23 and 88 as manufactured by 3M Company or an approved equal.
14. Plastic Vinyl Electrical Tape - 8.5 mil heavy duty, premium grade all-weather vinyl electrical insulating tape such as Scotch Premium Vinyl Electrical Tape 88 as manufactured by 3M Company or an approved equal.
15. Cable Ties - UV-rated nylon or stainless steel
17. Reinforcing Steel - All reinforcing steel shall be ASTM A 615, Grade 60.
18. Fillers and Adhesives - Joint sealing filler shall comply with Specification P-605 and Joint Sealing Filler and adhesive compounds shall comply with Specification P-606, Adhesive Compounds, Two-Component, For Sealing Wire and Lights and Pavement.

126-2.6 GROUNDING SYSTEMS CABLES

a. Grounding Cable Criteria:

1. Earth Electrode System (EES) – Provide #4/0 Bare Copper Stranded unless other identified.

2. Duct Bank Guard Wire (GW) – Provide #1/0 AWG Bare Copper Stranded unless otherwise identified
3. Equipment Grounding Conductors – Sized per NEC, provide #2 AWG minimum connection to EES. See N-134 for additional details. Bare ground conductors shall be sized in accordance with NEC and FAA-STD-019F. Minimum allowable size of ground conductors in contact with earth shall be not less than #2 AWG.

126-2.7 CONNECTOR PRODUCTS

Exothermic Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items. All underground conductor-to-conductor connections and conductor to ground rod connections shall be made by the exothermic weld process, unless otherwise noted. For certain materials and shapes which exothermic welds may not be possible, coordinate connection method with WRPM.

A. Substitutes: Provide exothermic connections equal to Cadweld. To substitute another exothermic weld process, the Subcontractor must submit a chemical analysis by an independent test laboratory certifying:

a. The material used contains no phosphorous, caustic, toxic or explosive substance.

b. Weld material used for ground connections contains copper oxide, aluminum and not less than 3% tin as a wetting agent. Weld metal for cathodic connections shall contain vanadium, but no tin.

c. A minimum of 80 percent of the weld metal shall screen out between 30 and 140 Mesh.

d. Exothermic Weld shall meet the applicable requirements of IEEE-80, Chapter 9, Section of Conductors and Joints.

e. Molds shall be made from graphite or other material withstanding welding temperatures and shall be designed to provide average life of not less than 50 exothermic welds under normal conditions. The molds shall bear permanent marking, indicating the name of the manufacturer, the mold model, the type, and size of the welding mixture compatible with the welding process and the size of the conductor. Instructions detailing general safety information, welding procedures shall be provided with each mold. The installer is prohibited from using a mold from one manufacturer with a different manufacturer’s welding mixture.

B. Application: Exothermic connections to be used outdoors shall be suitable for exposure to the elements and direct burial without degradation over the grounding system.

126-2.8 CIVIL MATERIALS

a. Backfill material. Trenching and backfilling for the PAPI conduits installation shall comply with

CONSTRUCTION METHODS

126-3.1 GENERAL

a) General. Whenever drawing details lack full clarity, the contractor shall still furnish all equipment, material, and labor to complete the installation work and accomplish all the intended functions of the electrical installation. The contractor shall ensure that the approach lighting aids electrical installation is coordinated and compatible with civil, mechanical, and electrical construction under this contract.

Minor departures from exact dimensions shown in the electrical plans may be permitted when required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The contractor shall promptly obtain approval from the Engineer before undertaking any such departure and shall provide appropriate documentation of the departure.

b) Shipping and Storage. Equipment should be shipped in suitable packing material to prevent damage during shipping. Equipment and materials should be maintained in new condition and stored in areas protected from weather and physical damage.

Any equipment and materials, in the opinion of the Engineer, damaged during construction or storage shall be replaced by the contractor at no additional cost to the owner. Painted or galvanized surfaces that are damaged shall be repaired according to manufacturer's recommendations.

126-3.2 EXCAVATION, TRENCHING & BACKFILLING

a) Verify site conditions. Verify that survey benchmark and intended elevations for the work are as indicated. Coordinate with FAA Sector Personnel and the Project Engineer to locate existing underground utilities. Identify and protect all existing utilities from damage. Protect benchmarks, existing structures, and fences, from excavation equipment and vehicular traffic. Locate the center of all PAPI foundations and stake excavation. Manually excavate and trim the surrounding earth to the required dimensions. Ensure only NFS material is below all foundations. Notify the Project Engineer of unusual subsurface conditions. Remove from the site any excess material not being reused. Protect the bottom of excavations and soil adjacent to and beneath foundation from freezing. Coordinate with the Project Engineer for on-site disposal of any excavated material when necessary. No excavated material may be disposed of on site without approval of the Project Engineer.

b) Protection of Existing Utilities and Cables. The location of existing utility lines and underground cables, as shown on the drawings, are approximate. Where the exact locations of existing ducts, pipes, or cable, etc., are required for construction purposes, the Contractor shall determine those locations in the field. The Contractor shall have a cable detector on site to locate any existing cables that he may encounter during construction operations. The Contractor shall immediately notify the Project Engineer if any proposed construction is located over any existing underground utilities.

The Contractor shall immediately repair, at their time and expense, any damage done by their personnel to utilities and/or cables within the work area. A written report shall be submitted immediately to the Project Engineer describing the type of services interrupted, the length of time that the services were out, and method used for repair.

Use hand excavation only when attempting to locate any existing power or signal cables. Record the As-built locations for all encountered utilities on the plans. Support and protect from damage all uncovered utility lines or features until approval for backfill is obtained from the Project Engineer.

c) Trenching and Backfilling. Trenching and backfilling for the PAPI conduit installation shall comply with specification Item L-110.

126-3.3 CONCRETE

Manually trim sides and bottom of earth forms to neat lines. Remove all loose soil prior to placing concrete. Place reinforcement wire to provide 3” of concrete cover over the reinforcement. Do not interrupt successive placement or permit cold joints to occur. Screed slabs on grade level, maintaining surface flatness of maximum ¼” deviation in 10’. Finish concrete slab surfaces to light broom swept, non-slip finish. Chamfer exposed corners of slabs 1”.

a) Curing and Protection. Immediately after placement, protect concrete from premature drying, excessively hot or freezing temperatures and mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete, a minimum of five (5) days.

b) Patching. Notify the Project Engineer to inspect concrete surfaces immediately upon removal of forms. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Project Engineer upon discovery of any concrete defects. Concrete that does not conform to the required lines, details, dimensions, tolerances, or specifications shall be repaired or removed and replaced by the Contractor as directed by the Project Engineer. The Project Engineer’s decision of whether to repair or replace defective concrete is final. The Contractor shall not patch, fill, touch-up, or repair exposed concrete defects except upon express direction of the Project Engineer.

126-3.4 GROUNDING AND BONDING

a) System Installation. Grounding and bonding shall be as shown on the plans and be accomplished in accordance with the base contract specifications.

The Earth Electrode System (EES) is the network of ground rods, conduit connection, equipment bonds and loop conductors, about equipment or structures. See FAA-STD-019 Item 4.4, FAA-C-1391 Item 5.11.2. All connections shall be made using exothermic connections equal to Cadweld field welds.

Guard Wire System, the network of ground rods, conduit connection, equipment bonds and counterpoise conductors shall. See FAA-STD-019 Item 5.4.3.3.3.2, FAA-C-1391 Item 5.11.2. All connections shall be made using exothermic connections equal to Cadweld field welds.

Grounding Electrode Conductors (GEC) – See FAA-STD-019 4.5.2

Equipment Grounding Conductors (EGG) – Supply an ECG conductor within all raceways for power and communication cables. Where power conductors and the EGC are to be extended to a second building or structure, the neutral to ground bond of the power system shall originate at the first building electrical service entrance point. The grounded conductor shall not be connected to the EGC or EES at the second building or structure. See FAA-STD-019 4.5.3

Earth Electrode System (Counterpoise) - Unless otherwise indicated on Contract Drawings, the grounding electrode system shall consist of a minimum of four (4) ground rods located at each corner of the structure.

A. Ground rods shall be interconnected by a buried, bare, #4/0 AWG, 7 stranded copper cable. The ground cable shall be directly buried at least 2’-6” below grade level. The interconnecting cable shall close on itself, forming a complete loop, with the ends exothermically welded. Provide sufficient mechanical protection during installation so as not to break cable or connections.

B. Connect structural steel of buildings to the earth electrode system with a bare, #4/0 AWG cable.

C. All underground metallic pipes, metallic conduit, tanks, and telephone ground shall be connected to the earth electrode system by a copper cable no smaller than #2 AWG. Exothermic welds shall not be used where hazards exist, i.e., near fuel tanks. In these cases, pressure connectors will be allowed as approved by engineer and FAA onsite representatives.

D. All exposed non-current carrying metallic parts of electrical and mechanical equipment including metallic raceway systems, piping, steel columns and structural members and neutral conductors of the wiring systems shall be grounded as required by the NEC and FAA-STD-019F.

E. Install ground cables in Schedule 80 PVC conduit where routed above grade, unless otherwise indicated on Contract Drawings.

F. Guard Wire: Install guard wire in trench lines where protecting PVC or direct buried cables. Locate guard wire 10 inches (minimum) above the conduit/cable. Connect guard wire to ground rods and the earth electrode system by exothermic means. Space ground rods at approximately 90-foot intervals along the trench line. Locate ground rods 2 feet outside of trench/handhole wall.

G. Ground pad-mounted equipment and non-current-carrying metal items by connecting them to Earth Electrode System by exothermic means.

H. Ground Rods: Install ground rods as follows:

a. Spacing: Ground rods shall be as widely spaced as practical and shall not be spaced less than one rod length apart. Spacing between rods around structures should be between 10 to 30 feet, nominal 20 feet, as shown on Contract Drawings.

b. Depth of rods: Tops of vertically driven ground rods shall be not less than 12 inches below grade level.

c. Location: Ground rods shall be located 2 to 6 feet outside the foundation or exterior footing of the structure.

d. Manholes and Handholes: Install a copper ground bus in each handhole/manhole. Install driven ground rods 2 feet from outside wall of handhole/manhole. Install a 2 AWG bare conductor from ground bus inside the manhole/handhole through a waterproof sleeve in manhole/handhole wall, and exothermically weld to the ground rod.

e. Access Wells: Install where indicated on contract drawings. Set top of well flush with finished grade or floor. Place gravel in well to a level 3 inches below ground rod connections

126-3.5 FIELD QUALITY CONTROL

A. Tests: Perform tests described below. Ensure no connection to utility power is made during testing.

a. Fall of Potential: Subject the completed EES system to an earth resistance test using a ground test null balance megger instrument designed for the purpose, such as a Biddle, utilizing the fall of potential method (3-point). Measure ground resistance not less than 3 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Earth Electrode System Resistance: The resistance of the earth electrode system shall not exceed 10 Ohms unless otherwise noted.

c. Bolting Resistance: Spot test to verify that ground cable bolted connections have a DC resistance of one milliohm maximum, when measured with a bridge type milli-ohmeter or similar instrument.

d. Continuity: Test ground conductors, sheet metal, metallic raceways, cellular metal deck, equipment enclosure, metallic enclosures, and lighting fixtures for continuity to ground system with a megger.

e. Bonding Resistance: Unless otherwise specified all bonds shall exhibit a resistance of one milliohm or less when measured between bonded members with a 4 terminal milliohm meter.

f. Witness: Tests shall be witnessed by Resident Engineer and Local FAA.

B. Performance Requirements.

Each EES shall have a resistance to earth no greater than 10 Ohms. Each EES System shall be tested before connection to guard wire of adjacent ductways.

The Guard Wires shall have a resistance to earth no greater than 10 Ohms. Each Guard Wire System shall be tested before connection to EES of adjacent electrical equipment or structures.

All low-voltage (≤ 600 V) cables (power and communication signals) shall measure not less than 50 megohms resistance between conductors and between conductors and ground. (Measured at 500V)

126-3.6 NAMEPLATES AND LABELS

a) General. Conform to requirements of ANSI/NFPA 70. Comply with FAA-C-1217 item 5.11

Degrease and clean surfaces to receive nameplates and labels. Install nameplate and label parallel to equipment lines. Secure nameplate to equipment front using screws or adhesive. Identify underground conduits using underground warning tape. Install one tape per trench at 6” below finished grade.

b) Locations. Nameplates and labels shall be placed on panel boards, switches, and self-enclosed circuit breakers, etc. Nameplates shall describe the functional name of the unit, voltage utilized, number of phases and other pertinent information. Switches for local lighting need not be identified. Each electrical distribution and control equipment enclosure shall be labeled.

c) Arc Flash Labels. The systems in this project are limited to single phase systems and only generic Arc Flash Labels shall be utilized. Contractor shall supply generic labels at equipment. Labels shall be suitable for exterior locations.

126-3.7 FIXTURE DEVICE INSTALLATION

Use an approved anti-seize compound on all installed hardware with external/internal threads, and where EMT conduit is inserted into frangible couplings. Failure to do this will result in the contractor replacing any items damaged due to seized, galled, or stripped threads or connections.

126-3.8 APPROACH AIDS

a) Coordination. Coordinate all shutdowns, equipment removals, startups, and commissioning with the

FAA.

b) Aiming. Leveling and Aiming of LHA to the satisfaction of the FAA, per the drawings. Use vendor supplied tools to set final aiming angles.

c) Fight Check Support. Provided Adjustment of LHA during FAA performed Flight Check, in conjunction with and under direction of FAA Staff.

Provided Testing and documentation in conjunction with FAA resident engineer.

126-3.9 FAA DOCUMENTATION (FORMS / CHECKLIST)

FAA Prepared forms for Contractor Reference

1. 3900-16 Project Planning Environmental and Occupational Safety and Health Checklist 2015-04
2. 3900-17 Design Risk Analysis for Environmental and Occupational Safety and Health Checklist 2015-04

Guidelines - OHSA

3. 3900-18 Pre-Construction Environmental and Occupational Safety and Health Checklist 2015-04

This document provides guidelines in the preparation of the Pre-Construction, Installation, and non-routine maintenance reviews for environmental, occupational, safety and health prior to start work that potentially has EOSH impacts on NAS operations and employees.

Contractor shall review and consider any FAA requirements in the preparation of the CSPP.

Guidelines – Arc Flash Evaluation

This Arc Flash user guide shall be review completely for Electrical Safety in the Workplace.

Always wear the appropriate PPE. Also review the flowchart including with this guide. If applied to you, filled out completely and acquire the forms attached to this guide.

Contractor shall provide the required Arc Flash labeling in accordance with FAA requirement for all new equipment installed following final testing, prior to acceptance by FAA. Calculations shall be provided by the contractor for engineer's review, as an initial submittal prior to any equipment submittals.

Procedure Forms

This format specified the procedure for a Lockout/Tagout for the Approach Lighting Aids system and shall be used to ensure that any person surrounding the equipment as well as personnel working on the equipment are protected from hazardous energy source.

This item shall supplement the contractors own Lock-out, Tag-out program as it pertains to FAA specific systems. Contractor shall fill out the sections corresponding to their scope of work.

Technical Reference Data Records

6000-08 Technical Performance (2019-12)

6000-10 Technical Reference Data Record (2008-09)

This Technical Reference Data Record form shall be filled correctly and acquire as possible for the appropriate device, refer to step number 8 of the Data Record sheet “Equipment/System Type”. Contractors shall provide required test equipment and personnel to perform all test required to fill out the system performance data. Test shall be supervised by FAA resident engineer, Owner’s representative, and contractor. The data shall be filled out the sections corresponding to the scope of work.

METHOD OF MEASUREMENT

126-4.1 3x3 Aircraft Rated Handhole will be measured per each system installed as a competed unit, ready in place, ready for operation and as accepted by the Engineer. The following items shall be included in the price of each unit: All required excavation and dewatering, sheeting, and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections and conduits; hardware and rack materials, temporary cables, and connections; labeling, and ground rod testing. The measurement includes all underground items 10’ outside of the structure, or 5’ outside of the EES loop where RGS conduit are required.

126-4.2 1W2” ductways of FAA standards will be measured per linear foot for each type and size of conduit completed and accepted, including trench and backfill with the designated material including concrete encasement. This item includes but not limited to trench marking tape, terminations, couplings, end bells, conduit plugs, conduit transitions, conduit connections, mandrelling, pulling lines, plugging of conduits, and duct markers as a completed system per the plans and specifications to the satisfaction of the Resident Engineer. Additionally, this item includes removal and disposal of existing duct banks and conduits as shown on the plans, testing, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications. Ductways shall include guard wire cabling installed over ducts and associated ground rods. The measurement includes all underground items 10 feet outside of the concrete foundations, or 5 feet outside of the EES loop where RGS conduit are required. Duct bank size variations not listed are to be inclusive in other lump sum items.

126-4.3 Runway Equipment Rack Replacement near Glide Slope (09L) Building will be measured per lump sum. This item includes but not limited to, removal of existing equipment racks and installation of new electrical distribution equipment racks. This item also includes all grounding, conduits, wireways, wiring (starting at the facility transformer), including reconnection of the existing Glide Slope shelters wiring, excluding wiring from PAPI disconnects [on the equipment rack near the Glide Slope shelters] to the PAPI equipment rack (Refer to specification section 128-4.1), racks, concrete foundation, connections, lightning protection, electrical equipment (disconnects, SPDS, etc.), and other incidentals detailed on the drawings for a fully operating system.

126-4.4 Runway Equipment Rack Replacement near Glide Slope (27R) Building will be measured per lump sum. This item includes but not limited to, removal of existing equipment racks and installation of new electrical distribution equipment racks. This item also includes all grounding, conduits, wireways, wiring (starting at the facility transformer), including reconnection of the existing Glide Slope shelters wiring, excluding wiring from PAPI disconnects [on the equipment rack near the Glide Slope shelters] to the PAPI equipment rack (Refer to specification section 128-4.1), racks, concrete foundation, connections, lightning protection, electrical equipment (disconnects, SPDS, etc.), and other incidentals detailed on the drawings for a fully operating system.

126-4.5 Electrical junction cans (L-867D) shall be measured by each unit completed in place and accepted. This item consists of the installation of the type of junction can noted, installed per the requirements of the drawings and specifications, at the indicated locations and conforming to the lines, grades and dimensions shown on the drawings or as required by the RPR. This item includes the installation of each structure with all associated excavation, backfilling, concrete encasement, appurtenances, all required connections, labels, dewatering, ground rod, ground cable, cadweld, test report and connections, steel cover, gasket, bolting hardware, and ID marker, and restoration of surfaces required, to the satisfaction of the RPR. This item additionally includes restoration of the site including site grading to prohibit ponding.

BASIS OF PAYMENT

126-5.1 Payment will be made at the Contract unit price for the complete installation of each system. Payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials and for all labor, supervision, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-126-5.1	3’x3’ Aircraft Rated Handhole (FAA Standards)	Per Each
Item L-126-5.2	1W2” Ductway (FAA Standards w/ Guard Wire)	Per Linear Foot
Item L-126-5.3	Runway 09L Equipment Rack Replacement Near Glide Slope Building	Per Lump Sum
Item L-126-5.4	Runway 27R Equipment Rack Replacement Near Glide Slope Building	Per Lump Sum
Item L-126-5.5	L-867D Pull Can with Concrete Encasement	Per Each

REFERENCES

126-6.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FAA / Department of Transpiration Standards

FAA-STD-019(f)	Lightning and Surge Protection, Grounding, Bonding, And Shielding

	Requirements for Facilities and Electronic Equipment
FAA-STD-1217(H),	Electrical Work, Premises Wiring
FAA-C-1391(e),	Installation, Termination, Splicing, And Transient/Surge Protection of Underground Electrical Distribution System Power Cables
FAA-G-2100H	Electronic Equipment, General Requirements

END OF ITEM L-126

ITEM L-127 APPROACH LIGHTING SYSTEM – MALS MODIFICATION (FAA OWNED)

DESCRIPTION

127-1.1 GENERAL

This item shall consist of all work required for the modifications of the existing Runway 09L and 27R Medium Intensity Approach Lighting System (MALS) as indicated on the construction drawings.

This item shall also include all wire and cable connections. It shall also include the testing of the installation and all incidentals necessary to place the MALS in operation as completed units to the satisfaction of the FAA, Airport and Engineer.

Equipment shall be manufactured, constructed, and installed in accordance with the manufacturer's standard plans and specifications. Provide equipment that meets all applicable requirements of the Federal Aviation Administration (FAA) and Federal Communication Commission (FCC).

Items within this specification shall be installed in accordance with FAA specifications. Refer to section 127-6.1 for additional references/criteria the contractor shall comply with. Specifications L-108, L-110 and L-125 shall not be applied to the approach lighting aids unless otherwise noted.

This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the FAA., Airport and Engineer. This item shall also include removal and disposal of all equipment and materials as shown on the plans.

Coordinate removal and re-installation of system components with FAA through the Engineer.

Verification of existing conditions such as locating, potholing, tracing coordination with FAA, local utilities and others deemed necessary shall be incidental to the pay items provided in this specification.

127-1.2 EXISTING MALS AND MALSR SYSTEMS

The existing system on runway 09L is a Medium Intensity Approach Lighting System with Runway Alignment Indicator (MALSR) system with RMS (remote monitoring subsystem), Type FA-11500, manufactured by the DME Corporation (Astronics / now Hughey Philips LLC). This unit consists of one (1) power and control assembly in a weatherproof enclosure (FA-11501) together with one (1) remote monitoring subsystem assembly (FA-11509) in a separate weatherproof enclosure. The RMS element is disabled. This system will be augmented with a <u>new</u> threshold bar consisting of empty conduits for future use, and with blank cover plates.

The existing system on runway 27R is MALS system with RMS (remote monitoring subsystem), Type FA-11500, manufactured by the DME Corporation (Astronics / now Hughey Philips LLC). This unit consists of one (1) power and control assembly in a weatherproof enclosure (FA-11501) together with one (1) remote monitoring subsystem assembly (FA-11509) in a separate weatherproof enclosure. The RMS element is disabled. The existing threshold will be <u>replaced</u> with new threshold infrastructure. The existing elevated lights will be removed and provided to the FAA. New inset type lights will be installed.

127-1.3 CONTRACTOR QUALIFICATIONS

Work shall be performed by a contractor licensed in the State of Florida, with a minimum of five years of electrical contracting experience in airfield electrical systems and experience with NAVAIDS / FAA Orders. Refer to Division 1 for required 'Contractor Qualifications Statement' that must be provided at time of bid addressing additional requirements.

EQUIPMENT AND MATERIALS

127-2.1 GENERAL

The Contractor shall furnish all material, equipment and incidentals as required for a complete installation as shown on the plans, unless identified as "FAA Furnished", "GFE" or "GFM". Unless otherwise shown, material and equipment shall be new and must comply with all contract documents and requirements. All material and equipment furnished by the Contractor shall be the standard products of manufacturers regularly engaged in the production of such material and be of the manufacturer's latest designs.

127-2.2 RWY 27R MALS SYSTEM

The modified MALS system shall conform to the requirements of FAA performance specification FA-1097, "Medium Intensity Approach Lighting System"

The existing MALS remote radio control system shall be reused. No control modification is required.

The existing shelter will remain with no modifications to the building structure.

127-2.3 MALS EQUIPMENT

Install all equipment, wiring and appurtenances to re-establish each existing MALS to an operational condition.

The minimum MALS equipment requirements shall be as follows:

1. Master Control Cabinet with lamps-out monitoring
   a. No expected modifications.
2. 15 kVA Transformer
   a. No expected modifications.
3. PAR 38 Lamp holders with PAR 38 lamps
   a. Select Systems will be deenergized and reused with new wiring.
4. PAR 56 Lamp holders with PAR 56 Lamps
   a. Existing Select Systems will be removed and provided to the FAA.
5. Inset Threshold Lights
   a. For Runway 27R -New Inset FA-23000-5 Green Med Intensity Fixtures with voltage transformers shall be provided. Fixtures shall be 12.5" OD to fit within L-868B light bases with pavement dams. Green filters with 3 x 63W lamps shall be provided.
   b. For Runway 09L – blank cover plates of 3/4" thickness shall be provided. The blank plates shall fit L-868B light bases with 5/8" pavement dams.
   c. Bolts shall be ceramic coated bolts per FAA engineering Brief 83A.
6. EMT and MG-Towers Assemblies
   a. Not impacted by project.

7. Elevated Sequenced Flashing Lights
    a. Not impacted by project.
8. Individual Control Cabinets (ICC)
    a. Not impacted by project.
9. High Voltage Interconnection Wires (Flasher Wiring)
    a. Not impacted by project.
10. Raceways and Junction Boxes and Handholes
    a. Refer to specification L-126
11. Aiming Device
    a. Existing FAA owned asset provided to contractor for installation of fixtures.
12. Spare Parts
    a. N/A to this project.
13. Technical Instruction Manual
    a. Existing Provided by the FAA for installation by the contractor.
14. Field Distribution Panel
    a. Remove existing direct buried wiring and install new wiring (installed in new raceways).
    b. Add new SPD Breaker and SPD device.

Although not a comprehensive list, the equipment above provides the minimum equipment requirements. The contractor will be responsible for coordinating complete MALS system equipment requirements based upon the plans, specifications and the specific MALS manufacturer submitted and approved by the Engineer.

Light bases / Base cans shall be installed with ½” spacer thickness allocation and with ½” thick pavement dam (5/8” dam depth). No more than two spacer rings are allowed to achieve the total thickness.

Refer to specification L-126 for other ELD system material properties.

127-2.4 INTERCONNECTION WIRING / CONDUIT.

Wiring / Conduit including size and type shall be as shown on the plans. Refer to specification L-126 for additional information.

127-2.5 UTILITY SERVICE TO MALS SHELTER

Existing to remain with no expected modifications.

127-2.6 PRODUCT SUPPORT AND WARRANTY

Refer to specification L-126-2.3.

127-2.7 ELECTRICAL STRUCTURES

For handholes and junction cans used in the MALS distribution system, refer to the details and specification L-126-2.3.

127-2.7 SURGE PROTECTIVE DEVICE

Provide 2P 50A breaker and Rayvoss 120-2S-M3-3-06-A in a stainless-steel enclosure. Supplement existing enclosure with strut to support new SPD enclosure.

CONSTRUCTION METHODS

127-3.1 REMOVAL/DEMOLITION

Removal and demolition of existing facilities, equipment, infrastructure that are indicated to be removed, shall be completely removed, and disposed of by the contractor. Work includes the removal of all above ground structures, foundations, pull boxes, and underground conduit and cabling (conduit and cable within 10 ft of the structures) associated with these facilities, equipment, and infrastructure. The sites shall be restored (including re-paving where necessary) to match the surrounding grade, compaction, and condition. All work shall be to the satisfaction of the FAA and the Airport. The contractor shall provide documentation to the FAA Project Engineer certifying that all material has been disposed of properly.

127-3.2 MALS TESTS

The system shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include the functioning of each control (Low, Medium, and High) in both Remote and Local not less than 10 times at the beginning and end of the 24-hour test.

Operational tests are not required for the 09L system, but base can placement and levelness shall be tested to the FAA satisfaction, with corrections provided as required.

127-3.3 MALS INSTALLATION

The equipment and components shall be installed by personnel experienced with the requirements and techniques involved with similar MALS installations. The personnel shall be thoroughly familiar with National Electrical Code and Federal Communications Commission (FCC) requirements. The personnel shall be thoroughly familiar with airport rules and regulations, and applicable safety requirements.

127-3.4 WIRES AND CABLES

Cable splices shall be per FAA-C-1391 Section 4.6.2. Splices shall not be allowed between units except in specified handholes or light bases.

Splices shall be made at outlets, junction boxes, pull boxes, manholes/handholes, or accessible raceways only. Splice 600V conductors in pull boxes only. Splices shall be made in manholes/handholes as indicated on the drawings only. All other splices within manholes/handholes shall require written approval

Splices shall be made with solderless connectors conforming to FS W-S-610, UL-486A, UL-486C, and UL-486E.

Wire nuts may only be used to splice conductors sized 10 AWG and smaller.

Compression connectors shall be used to splice conductors 8 AWG and larger. Use proper tool to provide circumferential pressure connection.

All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.

Splicing of ungrounded conductors in panelboards is not permitted.

Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

Use splice and tap connectors that are compatible with conductor material.

Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the FAA Resident Engineer prior to installation.

Conductors of different color insulation shall never be spliced together.

Keep conductor splices to a minimum.

A splice shall not be pulled into a duct or a raceway under any circumstances.

Install waterproof taps in underground structures.

All above ground cable used in steady burning lights shall be THWN or XHHW-2 stranded confirming to NEMA WC70. Insulation for conductor shall be rated at 75 degrees C.

All cables below ground shall be XHHW-2 stranded confirming to NEMA WC70. Insulation for conductor shall be rated at 75 degrees C. No cable shall be installed via direct burial methods.

All cable and conduit installation shall be in accordance with FAA-C-1391.

127-3.5 ELECTRICAL

a) General. Construction shall conform to the National Electrical Code (NEC) and all Federal, State, and local codes, laws and regulations required by the authority having jurisdiction. Where requirements of the authority having jurisdiction conflict with this specification yet are mandatory, they shall be followed the same as if specifically noted in this specification.

Only skilled workers, regularly engaged in this type of electrical work, shall work on the approach aid systems electrical installation. All work shall be performed under the supervision of licensed journeymen electricians and/or line worker only.

b) Color Coding. All 600 volt and below branch circuit and feeder conductors shall be color-coded as specified herein. The color-coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable in any part of the installation. The equipment-grounding conductor shall be covered with green insulation in sizes 6 AWG and smaller or shall be bare copper when shown or noted on the plans. Neutral conductors shall be covered in continuous white insulation in sizes 6 AWG and smaller. Conductors larger than 6 AWG shall be phase taped as follows:

120/240 volts:

Line 1 – Black

Line 2 – Red

Neutral – White

Ground – Green (unless bare conductor is call out)

Provide new SPDs at Existing panelboards.

127-3.6 ELECTRICAL TESTING

All low-voltage (≤ 600 V) cables (power and communication signals) shall measure not less than 50 megohms resistance between conductors and between conductors and ground. (Measured at 500V) Cables shall tested to FAA-C-1391 Section 3.3.5.5. Test both existing and cables separately, prior to connecting the new cables.

a. General. Furnish all necessary labor, materials, equipment, appliances, and power for conducting and performing operating tests on the completed systems. Testing includes insulation resistance testing and operation of the remote-control and the local control of the systems.

Final testing shall be witnessed by the Engineer and FAA personnel. Final adjustment and aiming will be done by contractor as direct by FAA personnel. Contractor shall repair systems that do not test satisfactorily at no additional cost to the Owner. Restart testing only after corrections are complete.

b. Operating Tests. Perform 30-minute system testing. After 30 minutes of operation, test system input voltages. Test systems using system specific control methodologies. Test photocells by covering the photocell control or as otherwise instructed by the FAA to ensure intensity adjustments. Test tilt switches if applicable. Test remote control function if applicable. Observe SPD visual indicators lamps.

c. Electrical Tests. Perform electrical test per FAA-C-1391 section 3.3.5.5.

d. Contractor shall supply all startup test in the Technical Instruction manual for the MALS FA-10097 system. FAA will provide all testing forms following the technical instruction manual.

127-3.7 CLEANUP

Upon completion of the project, the contractor shall clean around the project site and provided surface treatments per the civil plans for and specifications.

127-3.8 INSPECTION

The equipment shall be ‘ground tested’ prior to the ‘flight inspection’. The Contractor shall conduct tests as necessary to ensure that the system can be commissioned when flight inspected by the FAA. Pre-inspection shall be done 10 days prior to the flight check. All necessary adjustments to the system shall be made prior to flight checks.

Contractor shall arrange for and coordinate an FAA flight check for inspection and be on site and available for adjustments, as needed. The cost of flight checks is excluded from the contractor’s effort. The FAA will provide the flight checks (aircraft, observers, and testing reports). Contractor shall support two unique flight checks. as they may not necessarily be performed at the same time.

127-3.9 SURGE PROTECTIVE DEVICE

Install SPD on existing rack. Update panel schedule with added breaker and circuit identification.

METHOD OF MEASUREMENT

127-4.1 The MALS (09L) Threshold Infrastructure installation will be measured per lump sum. This item shall include but not limited to, conduit, ducts, base cans, blank base can covers, grounding, EES system, excavation, restoration, coordination with FAA, testing and all incidentals necessary to complete, in place. The additional elements supplement L-126 Items for a functional system and associated testing. Electrical items are inclusive of all field cabling identified on the drawings (unless identified as separate pay item), and all other work required to replace the existing system. The MALS system shall be accepted as a functional system, in place, tested and ready for operation to the satisfaction and acceptance by the FAA, Airport and Engineer. Threshold infrastructure pay item is inclusive of stub-out conduits for future provisions.

127-4.2 The MALS (27R) Threshold Infrastructure installation will be measured per lump sum. This item shall include but not limited to, conduit, ducts, base cans, installation of light fixtures, transformer, cabling, connectors, grounding, EES system, excavation, restoration, coordination with FAA, testing and all incidentals necessary to complete, in place. The additional elements supplement L-126 Items for a functional system and associated testing. Electrical items are inclusive of all field cabling identified on the drawings (unless identified as separate pay item), and all other work required to replace the existing system. The MALS system shall be accepted as a functional system, in place, tested and ready for operation to the satisfaction and acceptance by the FAA, Airport and Engineer. Threshold infrastructure pay item is inclusive of stub-out conduits for future provisions.

127-4.3 MALS Inset Light Fixtures will be measured per each. This item shall include all items as described in the contract documents (this specification and all plan sheets). This item includes all spare parts, labor, equipment, materials, tools, site preparation, assembly, and installation of materials.

127-4.4 MALS Rebuild Raceway Installation will be measured per lump sum. This item includes but not limited to, duct bank (type and size as shown on plans), counterpoise, grounding, EES system, warning tape, excavation, and backfill, terminations, couplings, end bells, conduit plugs, conduit transitions, conduit connections, mandrelling, pulling lines, plugging of conduits, duct markers, connections to existing structures, and other necessary duct bank / raceway installation effort for acceptance by FAA, Airport and Engineer. Cost excludes structures (Refer to specification L-126).

127-4.5 MALS Rebuild Electrical Cable Installation will be measured per lump sum. This item includes but not limited to, cables (type and size as shown on plans), taps, splices, labels, equipment panel connections, testing, and all other incidentals for a functional system.

127-4.6 MALS Rebuild Recommissioning will be measured per lump sum. This item includes but not limited to, performing and documenting all test per FAA supplied paperwork, supporting flight check, and other startup and commissioning activities. The contractor shall be responsible for costs of re-checking or additional flight checks of unsatisfactory installations.

127-4.7 MALS Rebuild Recommissioning RDR Sign Removal will be measured per each. This item provides for the removal of RDR sign of the type noted and associated equipment and cabling as identified in the drawings and specifications. Work for this item will be at the direction of the FAA in the event of a failed FAA PAPI flight check.

127-4.8 MALS Rebuild Recommissioning Wind Cone Relocation will be measured per each. This item provides for the relocation of the existing wind cone of the type noted and associated equipment and cabling as identified in the drawings and specifications. This item includes installation of the new concrete foundation with L-867D base can with steel cover, hub, gasket, bolting hardware, wind cone ID tag and marker, ground cable, ground rod with test results, grout, reinforcement bars all incidentals required to provide a complete and operational system. Work for this item will be at the direction of the FAA in the event of a failed FAA PAPI flight check.

BASIS OF PAYMENT

127-5.1 Payment will be made at the Contract unit price for the complete installation of each system. Payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials and for all labor, supervision, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-127-5.1	MALS 09L Threshold Infrastructure	Per Lump Sum
Item L-127-5.2	MALS 27R Threshold Infrastructure	Per Lump Sum
Item L-127-5.3	MALS Inset Threshold Light Fixture (FA-23000/5-Green)	Per Each
Item L-127-5.4	MALS 27R Rebuild Raceway Installation	Per Lump Sum
Item L-127-5.5	MALS 27R Rebuild Cable Installation	Per Lump Sum
Item L-127-5.6	MALS 27R Rebuild Recommissioning	Per Lump Sum
Item L-127-5.7	MALS 27R Rebuild Recommissioning – RDR Sign Removal	Per Each
Item L-127-5.8	MALS 27R Rebuild Recommissioning – Wind Cone Relocation	Per Each

REFERENCES

127-6.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FAA / Department of Transpiration Standards

FAA-STD-019(f)	Lightning and Surge Protection, Grounding, Bonding, And Shielding Requirements for Facilities and Electronic Equipment

FAA-STD-1217(H),	Electrical Work, Premises Wiring
FAA-C-1391(e),	Installation, Termination, Splicing, And Transient/Surge Protection of Underground Electrical Distribution System Power Cables
FAA-G-2100H	Electronic Equipment, General Requirements

END OF ITEM L-127

ITEM L-128 VISUAL GLIDES SLOPE SYSTEM – PAPI (FAA OWNED)

DESCRIPTION

128-1.1 GENERAL

This item shall consist of furnishing and installing a new Visual Glide Slope Systems as indicated on the construction drawings.

Coordinate removal of the existing system and installation of new system components with FAA through the Engineer.

Verification of existing conditions such as locating, potholing, tracing coordination with FAA, local utilities and others deemed necessary shall be incidental to the pay items provided in this specification.

128-1.2 CONTRACTOR QUALIFICATIONS

Work shall be performed by a contractor licensed in the State of Florida, with a minimum of five years of electrical contracting experience in airfield electrical systems and experience with NAVAIDS / FAA Orders. Refer to Division 1 for required ‘Contractor Qualifications Statement’ that must be provided at time of bid addressing additional requirements.

EQUIPMENT AND MATERIALS

128-2.1 EXISTING RWY 09L & 27R SYSTEMS

The existing runways consist of four box (2 sets) VASI Systems that are to be removed.

128-2.2 PROPOSED RWY 09L & 27R PAPI SYSTEMS

The new PAPI system will be Government Furnished Material (GFM) supplied by the FAA for installation by the contractor. Below is the PAPI GFM list.

The new PAPIs will be FA-30200 LED PAPI system. Contact for FAA approved PAPI manufacturer for any additional information:

New Bedford Panoramex
1480 N. Claremont Blvd,
Claremont CA, 91711 Phone: (909) - 982 – 9806

128-2.3 GOVERNMENT FURNISHED MATERIAL (GFM)

The Contractor will be responsible for inventory of the GFM and for its storage at the work site. GFM will be delivered directly to the airport. The Contractor will assist in offloading the GFM. The Contractor, in the presence of the FAA, shall inspect all the GFM listed within this specification. The Contractor and the FAA must inventory the GFM and indicate the quantities received in the space provided on the furnished material list. The furnished material list will be used as the property transferal document (Form 4650-12) and will be certified by the Contractor and the FAA at the time of transfer.

The Contractor will advise the FAA of any missing or damaged GFM or components. If the FAA is not given notification in writing of the damaged or missing components within this time period, the FAA will assume that the material is complete and ready for installation. Any replacement or correction of GFM will then become the Contractor's responsibility and any delays due to missing GFM will be the Contractor's responsibility.

The following is the GFM list for the FA-30200 LED PAPI system:

PAPI 09L

QTY	UNIT
1	Power and Control Assembly (93001407-01)
4	Lamp Housing Assemblies (LHA) - (93001449-01)
1	Set of Site Spares
1	Tilt Switch Assembly (93001105-02)
1	LED PAPI PCA Control, CCA (93001379-01)
4	Fuse (021502.5HXP)
1	CCA, LED PAPI LHA Control (93001411-01)
1	Super-T-Driver 121N.LG. 9/64 HEX (BT-T12-3)
2	Technical Instruction Books
1	Aiming Instrument Set (93001470-01)

PAPI 27R

QTY	UNIT
1	Power and Control Assembly (93001407-01)
4	Lamp Housing Assemblies (LHA) - (93001449-01)
1	Set of Site Spares
1	Tilt Switch Assembly (93001105-02)
1	LED PAPI PCA Control, CCA (93001379-01)
4	Fuse (021502.5HXP)
1	CCA, LED PAPI LHA Control (93001411-01)
1	Super-T-Driver 121N.LG. 9/64 HEX (BT-T12-3)
2	Technical Instruction Books
1	Aiming Instrument Set (93001470-01)

128-2.4 PAPI JUNCTION CAN

Junction can shall conform to the requirements of AC 150/5345-42. Junction cans shall be Type L-867 or L-868 or as indicated on the plans. Class 1A, Size B shall be provided as indicated or as required to accommodate the device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate the junction can size.

CONSTRUCTION METHODS

128-3.1 REMOVAL/DEMOLITION

Removal and demolition of existing facilities, equipment, infrastructure, and equipment that are indicated to be removed, shall be completely removed, and disposed of by the construction contractor. Work includes the removal of all above ground structures, foundations, pull boxes, and underground conduit and cabling (conduit and cable within 10 ft of the structures) associated with these facilities, equipment, and infrastructure. The sites shall be restored (including re-paving where necessary) to match the surrounding grade, compaction, and condition. All work shall be to the satisfaction of the FAA and the Airport. The contractor shall provide documentation to the FAA Project Engineer certifying that all material has been disposed of properly.

a) Removal of Existing Equipment. Contractor shall coordinate equipment de-energization with the FAA. The FAA will perform de-energization of the existing system.

128-3.2 APPROACH AIDS

a) Coordination. Coordinate all shutdowns, equipment removals, startups, and commissioning with the FAA.

b) Aiming. Leveling and Aiming of LHA to the satisfaction of the FAA, per the drawings. The PAPIs will be aimed using manufactures aiming hardware or built-in aiming support. The FAA will provide aiming angles.

c) Fight Check Support. Provide Adjustment of LHA during FAA performed Flight Check, in conjunction with and under direction of FAA Staff.

Provide testing and documentation in conjunction with FAA Resident Engineer.

128-3.3 TESTING

a. General. Furnish all necessary labor, materials, equipment, appliances, and power for conducting and performing operating tests on the completed systems. Testing includes insulation resistance testing and operation of the remote-control and the local control of the systems.

Final testing shall be witnessed by the Engineer. Repair systems that do not test satisfactorily shall be replaced at no additional cost to the Airport. Restart testing after corrections is complete.

b. Operating Tests. Perform 30-minute system testing. After 30 minutes of operation, test system input voltages. Test systems using system specific control methodologies. Test photocells by covering the photocell control or as otherwise instructed by the FAA to ensure intensity adjustments. Test tilt switches if applicable. Test remote control function if applicable. Observe SPD visual indicators lamps.

128-3.4 WIRES AND CABLES

Cable Splices shall be per FAA-C-1391 Section 4.6.2. Splices shall not be allowed between units except in specified handholes or light bases.

Splices shall be made at outlets, junction boxes, pull boxes, manholes/handholes, or accessible raceways only. Splice 600V conductors in pull boxes only. Splices shall be made in manholes/handholes as indicated on the drawings only. All other splices within manholes/handholes shall require written approval

Splices shall be made with solderless connectors conforming to FS W-S-610, UL-486A, UL-486C, and UL-486E.

Wire nuts may only be used to splice conductors sized 10 AWG and smaller.

Compression connectors shall be used to splice conductors 8 AWG and larger. Use proper tool to provide circumferential pressure connection.

All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.

Splicing of ungrounded conductors in panelboards is not permitted.

Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

Use splice and tap connectors that are compatible with conductor material.

Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the cable being spliced and shall be approved by the RE prior to installation.

Conductors of different color insulation shall never be spliced together.

Keep conductor splices to a minimum.

A splice shall not be pulled into a duct or a raceway under any circumstances.

Install waterproof taps in underground structures

All above ground cable used in steady burning lights shall be THWN or XHHW-2 stranded confirming to NEMA WC70. Insulation for conductor shall be rated at 75 degrees C.

All cables below ground shall be XHHW-2 stranded confirming to NEMA WC70. Insulation for conductor shall be rated at 75 degrees C. No cable shall be installed via direct burial methods.

All cable and conduit installation shall be in accordance with FAA-C-1391.

128-3.5 ELECTRICAL METHODS

a) General. Construction shall conform to the National Electrical Code (NEC) and all Federal, state, and local codes, laws and regulations required by the authority having jurisdiction. Where requirements of the authority having jurisdiction conflict with this specification yet are mandatory, they shall be followed the same as if specifically noted in this specification.

Only skilled workers, regularly engaged in this type of electrical work, shall work on the approach aid systems electrical installation. All work shall be performed under the supervision of licensed journeymen electricians and/or line worker only.

b) Color Coding. All 600 volt and below branch circuit and feeder conductors shall be color-coded as specified herein. The color-coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable in any part of the installation. The equipment-grounding conductor shall be covered with green insulation in sizes 6 AWG and smaller or shall be bare copper when shown or noted on the plans. Neutral conductors shall be covered in continuous white insulation in sizes 6 AWG and smaller. Conductors larger than 6 AWG shall be phase taped as follows:

120/240 volts:

Line 1 – Black

Line 2 – Red

Neutral – White

Ground – Green (unless bare conductor is call out)

c) Surge Protection. All surge arrestor in 100A Circuits and 70A Circuits must be Rayvoss 120-2S-M3-3-06-A. Provide new SPDs at Existing panelboards.

128-3.6 ELECTRICAL TESTING

All low-voltage (≤ 600 V) cables (power and communication signals) shall measure not less than 50 megohms resistance between conductors and between conductors and ground. (Measured at 500V) Cables shall tested to FAA-C-1391 Section 3.3.5.5. Test existing cables prior to connecting new cables.

a. General. Furnish all necessary labor, materials, equipment, appliances, and power for conducting and performing operating tests on the completed systems. Testing includes insulation resistance testing and operation of the remote-control and the local control of the systems.

Final testing shall be witnessed by the Engineer and FAA personnel. Final adjustment and aiming will be done by the Contractor as directed by FAA personnel. Contractor shall repair systems that do not test satisfactorily at no additional cost to the Owner. Restart testing after corrections is complete.

b. Operating Tests. Perform 30-minute system testing. After 30 minutes of operation, test system input voltages. Test systems using system specific control methodologies. Test photocells by covering the photocell control or as otherwise instructed by the FAA to ensure intensity adjustments. Test tilt switches if applicable. Test remote control function if applicable. Observe SPD visual indicators lamps.

c. Electrical Tests. Perform electrical test per FAA-C-1391 section 3.3.5.5.

128-3.7 PAPI EQUIPMENT TESTING

Provide all testing per the manufacturer Technical Instruction manual (TI 6850.108). This document can be obtained from the vendor (NBP Corp) or can be made available upon request via bidder question cycle.

128-3.8 CLEANUP

Upon completion of the project, the contractor shall clean around the project site.

128-3.9 INSPECTION

The equipment shall be ground tested prior to flight inspection. The Contractor shall conduct tests as necessary to ensure that the system can be commissioned when flight inspected by the FAA. All necessary adjustments to the system shall be made prior to flight checks. Contractor shall arrange for and coordinate an FAA flight check for inspection and shall be on-site during flight inspection and available for adjustments, as needed. In addition, the contractor must have a radio to be able to communicate with the FAA flight inspector during the inspection.

128-3.10 WARRANTIES

Materials will be owned by the FAA at conclusion of the project. Warranties shall be transferable to the FAA.

METHOD OF MEASUREMENT

128-4.1 PAPI 09L Infrastructure Including 4 PAPI Units (FAA Furnished), and Power and Control Assembly (FAA Furnished) will be measured per lump sum. This item shall include removal of existing VASI infrastructure and installation/placement of new PAPI system in operation. Additionally, this item includes but not limited to, all field wiring (starting from the equipment racks near the glide slope buildings) within the system, grounding, conduits, raceways, base assemblies, concrete foundations, junction cans, LHA units, power and control racks, and other incidentals detailed on the drawings for a fully operating system. This includes equipment rack and all power equipment such as disconnects, SPDs, and wiring of electrical distribution equipment. Item shall include all field testing provided by the contractor, flight check support and coordination with the FAA.

128-4.2 PAPI 27R Infrastructure Including 4 PAPI Units (FAA Furnished), and Power and Control Assembly (FAA Furnished) will be measured per lump sum. This item shall include removal of existing VASI infrastructure and installation/placement of new PAPI system in operation. Additionally, this item includes but not limited to, all field wiring (starting from the equipment racks near the glide slope buildings) within the system, grounding, conduits, raceways, base assemblies, concrete foundations, junction cans, LHA units, power and control racks, and other incidentals detailed on the drawings for a fully operating system. This includes equipment rack and all power equipment such as disconnects, SPDs, and wiring of electrical distribution equipment. Item shall include all field testing provided by the contractor, flight check support and coordination with the FAA.

BASIS OF PAYMENT

128-5.1 Payment will be made at the Contract unit price for the complete installation of each system. Payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials and for all labor, supervision, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-128-5.1	PAPI 09L Infrastructure Including 4-Box PAPI Units (FAA Furnished), and Power and Control Assembly (FAA Furnished)	Per Lump Sum
Item L-128-5.2	PAPI 27R Infrastructure Including 4-Box PAPI Units (FAA Furnished), and Power and Control Assembly (FAA Furnished)	Per Lump Sum

REFERENCES

128-6.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FAA / Department of Transpiration Standards

FAA-STD-019(f)	Lightning and Surge Protection, Grounding, Bonding, And Shielding Requirements for Facilities and Electronic Equipment
FAA-STD-1217(H),	Electrical Work, Premises Wiring
FAA-C-1391(e),	Installation, Termination, Splicing, And Transient/Surge Protection of Underground Electrical Distribution System Power Cables
FAA-G-2100H	Electronic Equipment, General Requirements
TI 6850.108	Technical Instruction manual for FA-30200 LED PAPI System

END OF ITEM L-128

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ITEM L-129 DIRECTIONAL DRILL

DESCRIPTION

129-1.1 GENERAL

This item shall consist of furnishing and installing underground raceways using the method of installation commonly referred to as horizontal directional drill / directional boring. This item shall include all services, equipment, materials, tracking and tracing, connection to structure and adjacent raceway and labor for the complete and proper installation, testing and restoration of disturbed ground. A No. 1/0 AWG copper guard wire shall be installed with and external to the directional drill duct. Quantity of counterpoise shall be per the details. The No. 1/0 AWG copper guard wire shall be incidental to the directional bore and shall not be paid separately.

Verification of existing conditions such as locating, potholing, tracing coordination with FAA, local utilities and others deemed necessary shall be incidental to the pay items provided in this specification.

SUBMITTALS

129-2.1 WORK PLAN. Prior to beginning work, the Contractor must submit to both the Engineer, RPR, and FAA field representee, a comprehensive work plan outlining the procedure, duct configuration of each drilling bundle, logistics plan and schedule to be used to execute each drilling location. Prior to the initiation of any installation this work plan must be submitted and accepted by the Owner. The work plan shall define the procedures for accomplishing the directional boring, duct configurations, depths, routes and locating of existing underground utilities and cables of any type, protection of all existing utilities and cables and procedures for connection to electrical structure and base cans at various locations along the directional drill. The Contractor shall also provide documentation of the intended depth of the directional bore along its entire length and the method used for horizontal/vertical control of the directional drilling.

129 2.2 EQUIPMENT. The Contractor shall submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project.

129 2.3 MATERIAL. Specifications on the material to be used in the directional drilling shall be submitted to the Engineer. The material shall include the pipe, conduit, fittings and any other items which are to be an installed component of the project.

EQUIPMENT/CONSTRUCTION

129-3.1 GENERAL. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

129-3.2 GUIDANCE & TRACKING SYSTEM. The guidance tracking systems shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. Directional drilling operations shall not take place unless the Contractor is actively scanning and tracking the bore. The Contractor shall track both lateral location and bore head depth throughout the entire length of the bore. The operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system. The Contractor shall maintain record documents for each bore indicating the depth of the run on 25' intervals and at any significant change in depth or direction.

In addition to the 25' interval identified additional depth measurement shall be taken on all pavement crossings. Depth measurements shall be taken and recorded at:

1. Centerline of the taxiway or runway.

2. Pavement edge on both sides of centerline.

129-3.3 CONDUIT/DUCT. The conduit/duct shall be Schedule 80 HDPE or equivalent SDR 11 HDPE, suitable for placement with directional drilling under pavement. The Contractor is responsible for the selection of pulling hardware, couplings, connectors, fittings and terminations in the electrical structures. All material shall comply with manufacturer recommendations and shall be compatible with the proposed directional drill method and equipment used during the installation.

129-3.4 EXECUTION. The RPR must be notified 72 hours in advance of starting work to allow for the coordination of safety and operations. The directional bore shall not begin until the RPR is present at the job site and agrees that proper preparations for the operation have been made. The RPR approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. Repair of any damage to existing pavements, sub grades or existing facilities as a result of boring operations shall be the responsibility of the Contractor.

The Contractor shall provide documentation that all underground utilities and cable systems have been located, staked and depths confirmed. No work shall begin until the RPR and Owner are assured that the directional boring operation will not result in any utilities or cable system being cut or damaged. The Contractor shall perform soft dig /potholing of the existing underground utilities and/or cable systems that are in potential conflict with the proposed installations to accurately establish their depths.

In directional drill installations of duct banks greater than 6-way, the Contractor may elect, for his convenience, to pull multiple bundles in close lateral proximity in lieu of a single bundle consisting of one large pull. As part of the work plan, the Contractor shall designate the proposed duct configurations, depths and bundle separation for each crossing for approval by the RPR. If the Contractor elects to drill in multiple bundles, the payment shall be made on the total quantity pulled at that crossing, not as multiple crossings of smaller configuration.

METHOD OF MEASUREMENT

129-4.1 The quantity of directional drill to be paid for shall be the number of linear feet, installed, measured in place, completed, and accepted. No separate measurement shall be made for the various types and sizes. Counterpoise/guard wire shall be incidental to the directional drill as it will be installed in the same action.

BASIS OF PAYMENT

129-5.1 Payment will be made at the Contract unit price for the complete installation of each system. Payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials and for all labor, supervision, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-129-5.1	Directional Drill Conduit, 1 Way, 2-Inch HDPE	Per Linear Foot

REFERENCES

129-6.1 REFERENCES

None

END OF ITEM L-129

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Geotechnical Data Report

Miami Opa-Locka Executive Airport
Rehabilitation of OPF Runway 97-27R
Opa-Locka, Florida
January 12, 2022
Terracon Project No. H8205120

Prepared for:
Atkins Global
Miami, Florida

Prepared by:
Terracon Consultants, Inc.
Miami Lakes, Florida

January 12, 2022

Atkins Global
800 Waterford Way, Ste 700
Miami, Florida 33126

Attn: **Mr. Carlos J. Arboleda Osorio, PE *, M. ASCE**
P: (787) 630 3284
E: carlos.arboleda@atkinsglobal.com

Re: Geotechnical Data Report
Miami Opa-Locka Executive Airport
Rehabilitation of OPF Runway 97-27R
14201 NW 42nd Avenue
Opa-Locka, Florida
Terracon Project No. H8205120

Dear Mr. Arboleda-Osorio:

This geotechnical data report summarizes the results of the soil borings, cores, and laboratory testing that can be used for the design and construction of the above referenced project. This study was performed in general accordance with Terracon Proposal PH8205042, dated December 8, 2020. This geotechnical data report presents the findings of the subsurface exploration along the OPF Runway 97-27R, encountered at the boring/core locations, and laboratory test results.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Colin T. Henderson
Project Engineer

Hugo E. Soto, P.E.
Principal
FL Registration No. 36440

HUGO E SOTO LICENSE No. 36440 STATE OF FLORIDA PROFESSIONAL ENGINEER

REPORT TOPICS_Toc92689703

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Data Report

Miami Opa-Locka Executive Airport
Rehabilitation of OPF Runway 97-27R
14201 NW 42nd Avenue
Opa-Locka, Florida
Terracon Project No. H8205120
January 12, 2022

INTRODUCTION

This geotechnical data report is based on the results of our subsurface exploration and geotechnical engineering services performed for the proposed Rehabilitation of OPF Runway 97-27R at the Miami Opa-Locka Executive Airport in Opa-Locka, Florida.

A total of twenty-eight (28) borings (B-1 through B-28) were performed to depths of about 6.9 to 11.3 feet below the existing pavement surface as directed by the client. Dynamic cone penetrometer (DCP) tests were performed at the boring locations, except for B-23 which was eliminated from the project. In addition, a total of sixty-seven (67) pavement cores were extracted, which included twenty-eight (28) cores at the boring locations (B-1 through B-28) and thirty-nine (39) cores without borings (C-1 through C-39). This report presents the pavement/base course/stabilized subgrade thicknesses and subsurface soil conditions encountered at the boring locations, as well as laboratory test results.

The **Site Location and Exploration Plans** are included in the attachments of this report. The results of the laboratory testing performed on soil samples obtained from the borings are included on the boring logs and laboratory test reports enclosed in the **Exploration Results** section. Descriptions of the field exploration and laboratory testing are included in the **Exploration and Testing Procedures** section.

PROJECT INFORMATION

Site Location and Description

ITEM	DESCRIPTION
Location	The project is located at the Miami Executive Airport at the address of 14201 NW 42nd Avenue in Opa-Locka, Florida. See Site Location and Exploration Plans attached.
Existing Site Improvements	The site consists of existing runways and taxiways that are asphalt and/or concrete paved.

Project Description

ITEM	DESCRIPTION
Planned Improvements	It is anticipated that the runways and taxiways will be rehabilitated via mill and overlay with new hot mix asphalt or reconstruction. Reconstruction, if chosen, is anticipated included the removal of the existing pavements, stabilization of the existing subgrade, and replacement with a new asphalt and/or concrete section.
Grading	It is anticipated that finished grades of the runways and taxiways will be within 1/2 foot of the existing pavement surface.

GEOTECHNICAL CHARACTERIZATION

The subsurface conditions encountered at each boring location (B-1 through B-28) are indicated on the borings logs and dynamic cone penetrometer field reports in the **Exploration Results** section of the attachments. The pavement thicknesses, pavement crack depths, as well as bottom-of-rebar depths and rebar diameters for concrete pavements, are indicated in the summary table presented below. The **Exploration and Testing Procedures** section presents the procedures followed during our field exploration.

Groundwater

The test borings were monitored while drilling for the presence and level of groundwater during drilling. The depth to groundwater ranged between 3.6 to 6.9 feet below ground surface, with . exception of borings B-10 and B-12 where the groundwater was not encountered. The water levels as observed in the boreholes during drilling are noted on the attached Boring Logs and are summarized in the following table.

Boring	Depth to Groundwater While Drilling (ft.) [1]	Boring	Depth to Groundwater While Drilling (ft.) [1]
B-1	5.6	B-17	4.7
B-2	6.6	B-18	4.5
B-3	6.6	B-19	4.3
B-4	5.5	B-20	3.6
B-5	6.5	B-21	5.1
B-6	6.7	B-22	6.2
B-7	6.9	B-23	4.9
B-8	6.7	B-24	6

Boring	Depth to Groundwater While Drilling (ft.) [1]	Boring	Depth to Groundwater While Drilling (ft.) [1]
B-9	6.9	B-25	6
B-10	Not encountered	B-26	6.1
B-11	6.6	B-27	6.2
B-12	Not encountered	B-28	5.9
B-13	5.5		
B-14	5.5		
B-15	6.9		
B-16	5.5		

1. Below ground surface.

These observations represent groundwater conditions at the time of the field exploration, and may not be indicative of other times, or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. In addition, perched water can develop over low permeability soil strata following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Fluctuations in groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells and periodic measurement of groundwater levels over a sufficient period of time.

Regional Geology

Miami-Dade County is located in the Coastal Lowlands region of the Florida peninsula. The coastal lowlands consist of nearly level plains, and within Dade County the land surface is generally below Elevation +25 MSL. The surficial soils are comprised of pockets and remnants of Pamlico Sands. The sands are underlain by Miami Limestone (oolitic limestone) followed by limestone and/or sandstone and sand lenses of the Fort Thompson and Tamiami Formations.

The Pamlico Formation is composed of non-fossiliferous, unconsolidated quartz fine sand. Except where outcrops of limestone and man-made fills occur, this formation covers the Miami Limestone. Miami Limestone can be found at or near the surface in the Miami-Dade area. This formation is an oolitic limestone that is generally less than 40 feet thick. It characteristically contains large quantities of ooliths, which are small, spherical particles formed when calcite or aragonite was deposited in concentric layers around a nucleus of some type. This formation contains solution channels in the limestone which may be up to several feet in diameter at some locations and are filled with quartz fine sand and uncemented calcareous materials. The limestone varies in both thickness and competency within the investigated area. The degree of cementation, and therefore the competency of the rock, was influenced by both the abundance and the type of calcareous material in the original deposit.

The Fort Thompson Formation, which consists of interbedded limestone, sand, and shells, is one of the most productive units within the Biscayne aquifer. It averages 50 to 70 feet in thickness. It typically consists of alternating freshwater and marine sediments, which generally are permeable. The limestone beds in the Fort Thompson Formation can be cavernous and interconnected, thus providing channels through which water can flow. The Fort Thompson Formation is composed of sediments of variable lithologies. The lithologies include non-fossilferous quartz fine sand, fossilferous quartz sandy limestone, coralline limestone, freshwater limestone and quartz sandstone. These lithologies alternate abruptly in thickness and lateral extent.

TABLE 1: SUMMARY OF ASPHALT/CONCRETE THICKNES WITH CRACK DEPTH AND REBAR DEPTH AND DIAMETER

CORE NUMBER	ASPHALT LAYER THICKNESS (In)	CONCRETE LAYER THICKNESS (In)	Crack Depth Below Pavement Surface (In)	Bottom of Rebar Depth Below Pavement Surface Pavements (In)	Rebar Diameter (In)
B-1	2.0	Not Encountered	Not Encountered	N/A	N/A
B-2	5.5	9.75	Not Encountered	9.5 and 9.75	0.25
B-3	8.75	10.0	Not Encountered	11.625 and 11.875	0.25
B-4	3.25	Not Encountered	Not Encountered	N/A	N/A
B-5	9.75	Not Encountered	1.75	N/A	N/A
B-6	9.625	Not Encountered	Not Encountered	N/A	N/A
B-7	10.25	Not Encountered	Not Encountered	N/A	N/A
B-8	7.5	Not Encountered	2.375	N/A	N/A
B-9	8.0	Not Encountered	Not Encountered	N/A	N/A
B-10	8.0	Not Encountered	Not Encountered	N/A	N/A
B-11	7.75	Not Encountered	Not Encountered	N/A	N/A
B-12	6.75	Not Encountered	Not Encountered	N/A	N/A
B-13	2.75	Not Encountered	Not Encountered	N/A	N/A
B-14	2.25	9.25	Not Encountered	3.25	0.25
B-15	6.25	9.75	Not Encountered	8.75	0.25

CORE NUMBER	ASPHALT LAYER THICKNESS (In)	CONCRETE LAYER THICKNESS (In)	Crack Depth Below Pavement Surface (In)	Bottom of Rebar Depth Below Pavement Surface Pavements (In)	Rebar Diameter (In)
B-16	1.75	Not Encountered	Not Encountered	N/A	N/A
B-17	Not Encountered	10.25	Not Encountered	4.375	0.25
B-18	Not Encountered	10.0	Not Encountered	3 to 3.25	0.25
B-19	Not Encountered	10.25	Not Encountered	4.75	0.25
B-20	Not Encountered	9.75	Not Encountered	4.625 and 5	0.25
B-21	2.25	9.75	Not Encountered	6.25	0.25
B-22	3.25	Not Encountered	Not Encountered	N/A	N/A
B-23	1.375	Not Encountered	Not Encountered	N/A	N/A
B-24	1.375	Not Encountered	Not Encountered	N/A	N/A
B-25	Not Encountered	9.75	Not Encountered	4.125 and 4.5	0.25
B-26	Not Encountered	10.0	Not Encountered	4.25	0.25
B-27	Not Encountered	10.25	Not Encountered	4.75	0.25
B-28	Not Encountered	9.5	Not Encountered	3.375	0.25
C-1	6.5	9.5	6.5 to 16	10 and 12	0.25
C-2	6.25	9.25	Not Encountered	9.375 and 11.75	0.25, 0.375, and 1.25
C-3	11.0	Not Encountered	1.75	N/A	N/A
C-4	6.125	Not Encountered	0.75	N/A	N/A
C-5	10.875	Not Encountered	2.0	N/A	N/A
C-6	8.25	Not Encountered	3.5	N/A	N/A
C-7	9.875	Not Encountered	0.625	N/A	N/A
C-8	6.25	Not Encountered	0.5	N/A	N/A
C-9	6.875	Not Encountered	0.25	N/A	N/A
C-10	10.5	Not Encountered	1.0	N/A	N/A
C-11	9.875	Not Encountered	0.5	N/A	N/A
C-12	5.75	Not Encountered	0.75	N/A	N/A
C-13	11.25	Not Encountered	Not Encountered	N/A	N/A
C-14	9.25	Not Encountered	0.5	N/A	N/A
C-15	6.0	Not Encountered	1.875	N/A	N/A
C-16	5.5	Not Encountered	1.125	N/A	N/A

CORE NUMBER	ASPHALT LAYER THICKNESS (In)	CONCRETE LAYER THICKNESS (In)	Crack Depth Below Pavement Surface (In)	Bottom of Rebar Depth Below Pavement Surface Pavements (In)	Rebar Diameter (In)
C-17	6.0	Not Encountered	3.25	N/A	N/A
C-18	7.875	Not Encountered	3	N/A	N/A
C-19	5.75	Not Encountered	2.5	N/A	N/A
C-20	5.75	Not Encountered	0.75	N/A	N/A
C-21	9.0	Not Encountered	0.5	N/A	N/A
C-22	9.5	Not Encountered	Not Encountered	N/A	N/A
C-23	8.625	Not Encountered	2.125	N/A	N/A
C-24	6.75	Not Encountered	1.25	N/A	N/A
C-25	9.125	Not Encountered	1.5	N/A	N/A
C-26	9.125	Not Encountered	0.75	N/A	N/A
C-27	7.5	Not Encountered	1.875	N/A	N/A
C-28	3.75	8.5	3.75 to 12.25*	5.875 and 7.5	0.25
C-29	4.5	9.75	4.5 to 14.25*	5.75 and 7.125	0.25
C-30	Not Encountered	10.25	Not Encountered	3.875	0.25
C-31	Not Encountered	10.0	Not Encountered	4.25	0.25
C-32	4.25	Not Encountered	Not Encountered	N/A	N/A
C-33	3.0	Not Encountered	Not Encountered	N/A	N/A
C-34	3.75	Not Encountered	1.0	N/A	N/A
C-35	5.375	Not Encountered	1.875	N/A	N/A
C-36	3.625	Not Encountered	Not Encountered	N/A	N/A
C-37	4.75	Not Encountered	0.75	N/A	N/A
C-38	3.625	Not Encountered	Not Encountered	N/A	N/A
C-39	4.0	Not Encountered	Not Encountered	N/A	N/A

Note: N/A = Not Applicable

* Cracking was only observed within the concrete layer of the extracted core.

PAVEMENTS

We understand that the pavement analysis and design will be performed by ATKINS. Additionally, we understand that ATKINS will utilize the subsurface data obtained from our study to design new or replace existing pavement sections throughout the OPF Runway 97-27R. We recommend the results of the Dynamic Cone Penetration (DCP) field test results, which were used to obtain

California Bearing Ratio (CBR) data, be used for pavement design. The CBR data should be reviewed by the design engineer to determine if the existing subgrade conditions areas are suitable for support of the new pavement sections.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through the GeoReport system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Exploration / Test Locations	Type of Exploration Test Performed	Exploration Depth (feet) [1]	Planned Location
28 (B-1 through B-28)	Boring	6.9 to 11.3[2]	Existing Runways / Taxiways
27 (B-1 through B-22, B-24 through B-28)	DCP	1.11 to 3.63[3]	Existing Runways / Taxiways
67 (B-1 through B-28, C-1 through C-39)	Pavement Core	N/A	Existing Runways / Taxiways

1. Below ground surface
2. The borings were terminated at exploration depths as directed by the client's field representative.
3. DCP tests were advanced to depths as directed by the client's field representative

Boring Layout and Elevations: The boring/DCP and core locations were selected and located in the field by the client. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced soil borings with a truck-mounted drill rig using continuous flight augers. Continuous 2-foot samples were obtained within the upper 6.9 to 11.3 feet, depending on the boring termination depth that was instructed by client's field representative. Samples were obtained using split barrel sampling procedures, in which a standard 2-inch outer diameter split barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during drilling and sampling.

At the DCP test locations, we performed a dynamic cone penetrometer (DCP) test using a Dual-Mass Hammer to depths ranging from 1.11 to 3.63 feet below ground surface elevation. This device provides a continual profile of the stiffness of the soil with depth, and a rough correlation with the subgrade CBR value (strength parameter used by pavement engineers to design pavement thicknesses).

The pavement cores were extracted by using a diamond encrusted 6-inch diameter core barrel. Each of the cores was placed in a container and then transported to our laboratory for measurement and photography. Upon completion, each of the cores was patched with cold patch asphalt to surrounding grade.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory tests.

Property Disturbance: We backfilled the borings with grout after completion as appropriate. The borings and cores were patched with asphalt or quick set concrete as appropriate.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. The following tests were performed for this project.

- Water content
- Grain size distribution
- Organic content
- Laboratory CBR
- Indirect Tensile Strength

The laboratory test program included visual examination of the soil samples by the project engineer. Based on the texture and plasticity, we described and classified the soil samples in general accordance with the Unified Soil Classification System (USCS).

SITE LOCATION AND BORING LOCATION PLANS

SITE LOCATION PLAN

Miami Opa-Locka Executive Airport – Rehabilitation of OPF Runway 97-27R

Opa-Locka, Florida ■ January 12, 2022 ■ Terracon Project No. H8205120

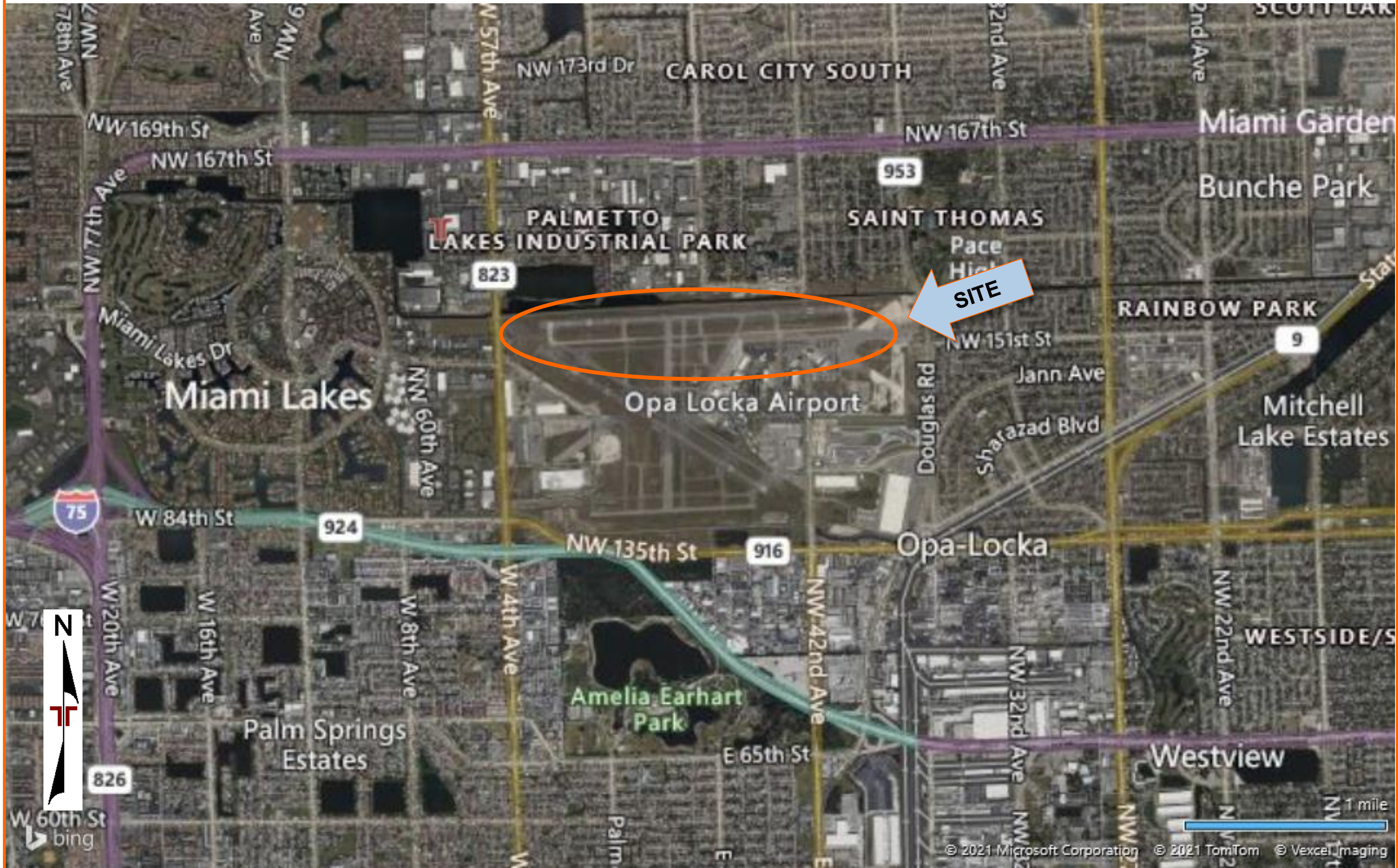

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

SITE LOCATION PLAN

Rehabilitation of OPF Runway 97-27R ■ Opa-Locka, FL

January 12, 2022 ■ Terracon Project No. H8205120

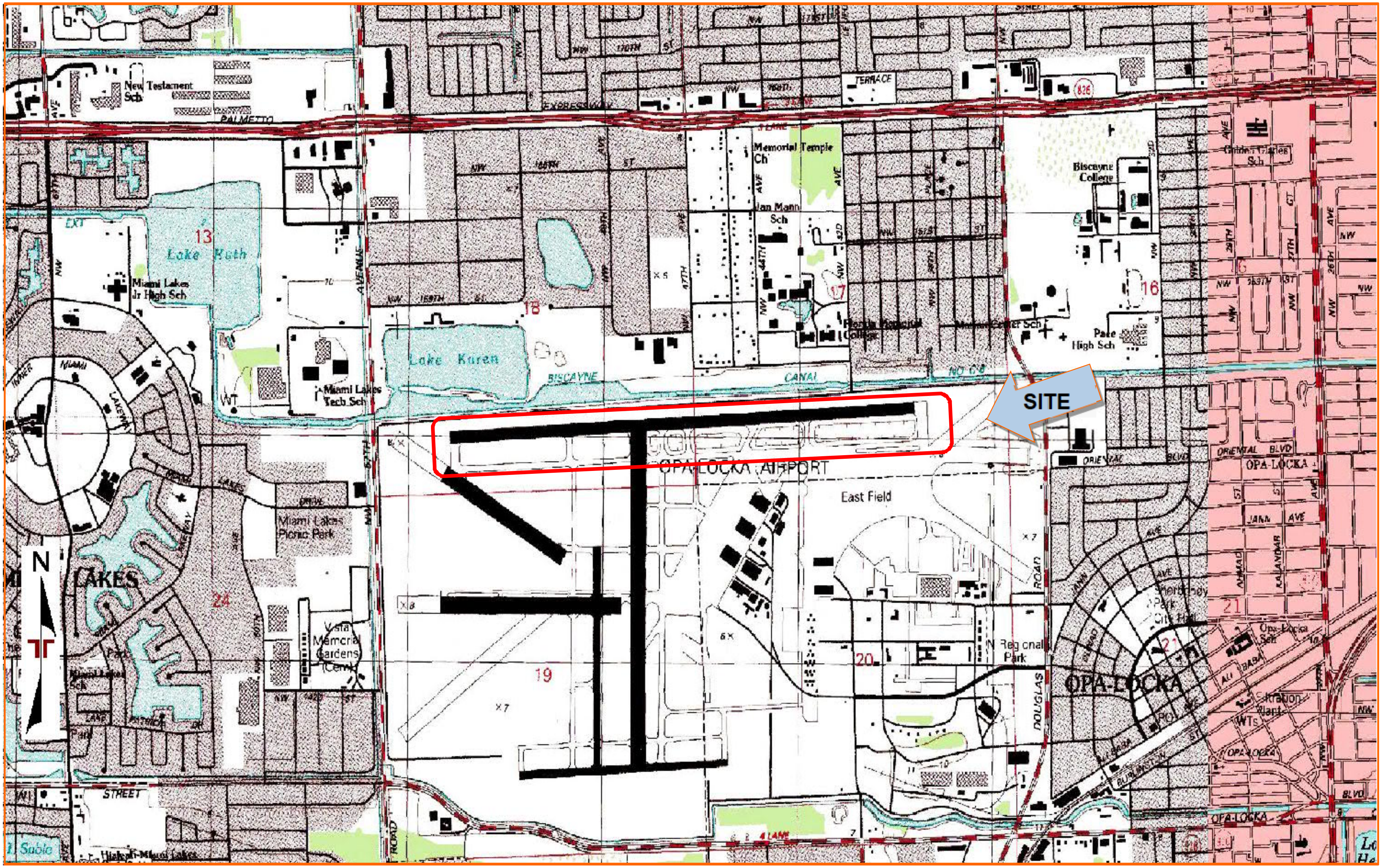

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: OPA-LOCKA, FL (1/1/1988) and NORTH MIAMI, FL (1/1/1994).

EXPLORATION PLANS

Rehabilitation of OPF Runway 97-27R ■ Opa-Locka, FL

January 12, 2022 ■ Terracon Project No. H8205120

Terracon GeoReport

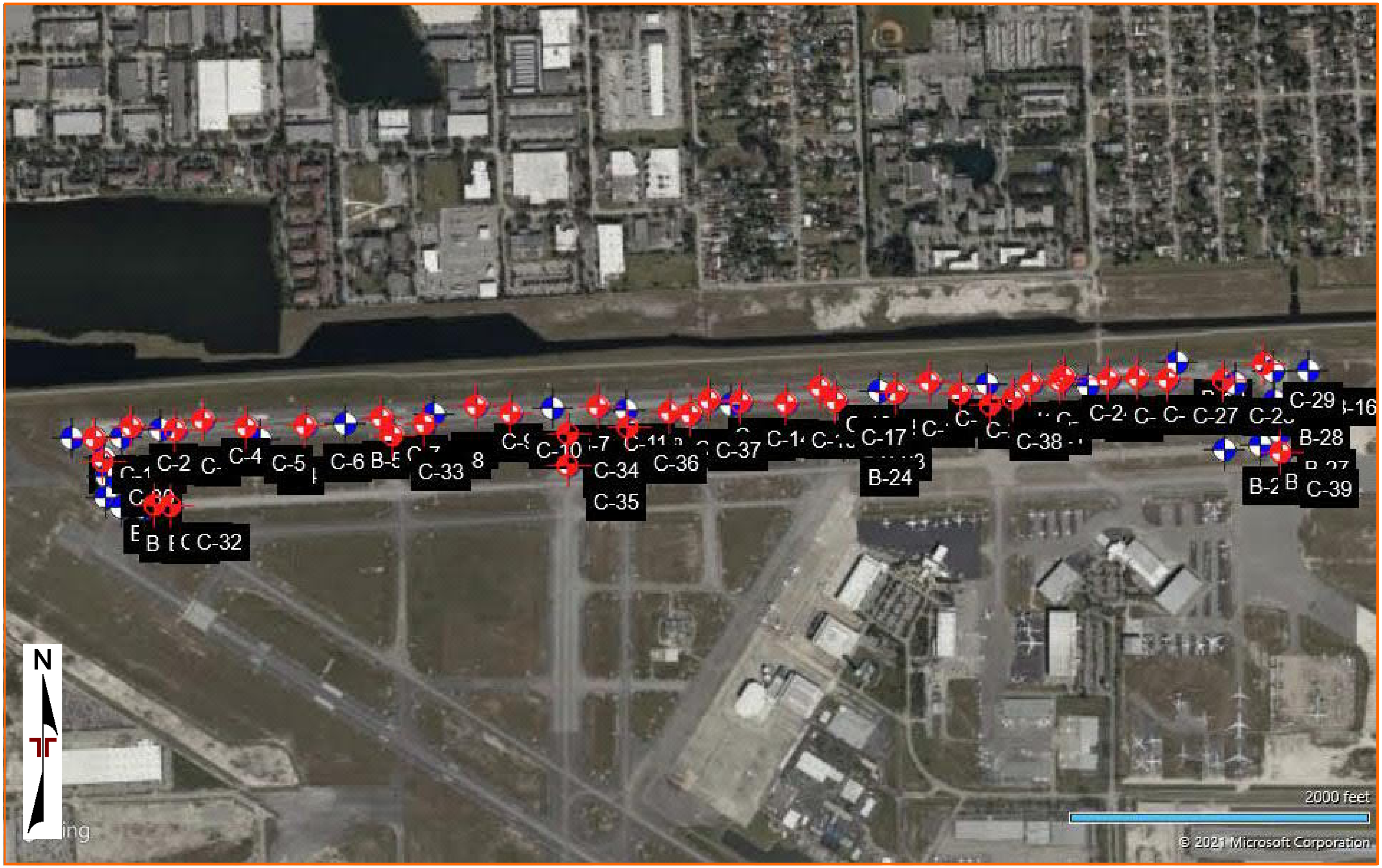

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLANS

Rehabilitation of OPF Runway 97-27R ■ Opa-Locka, FL

January 12, 2022 ■ Terracon Project No. H8205120

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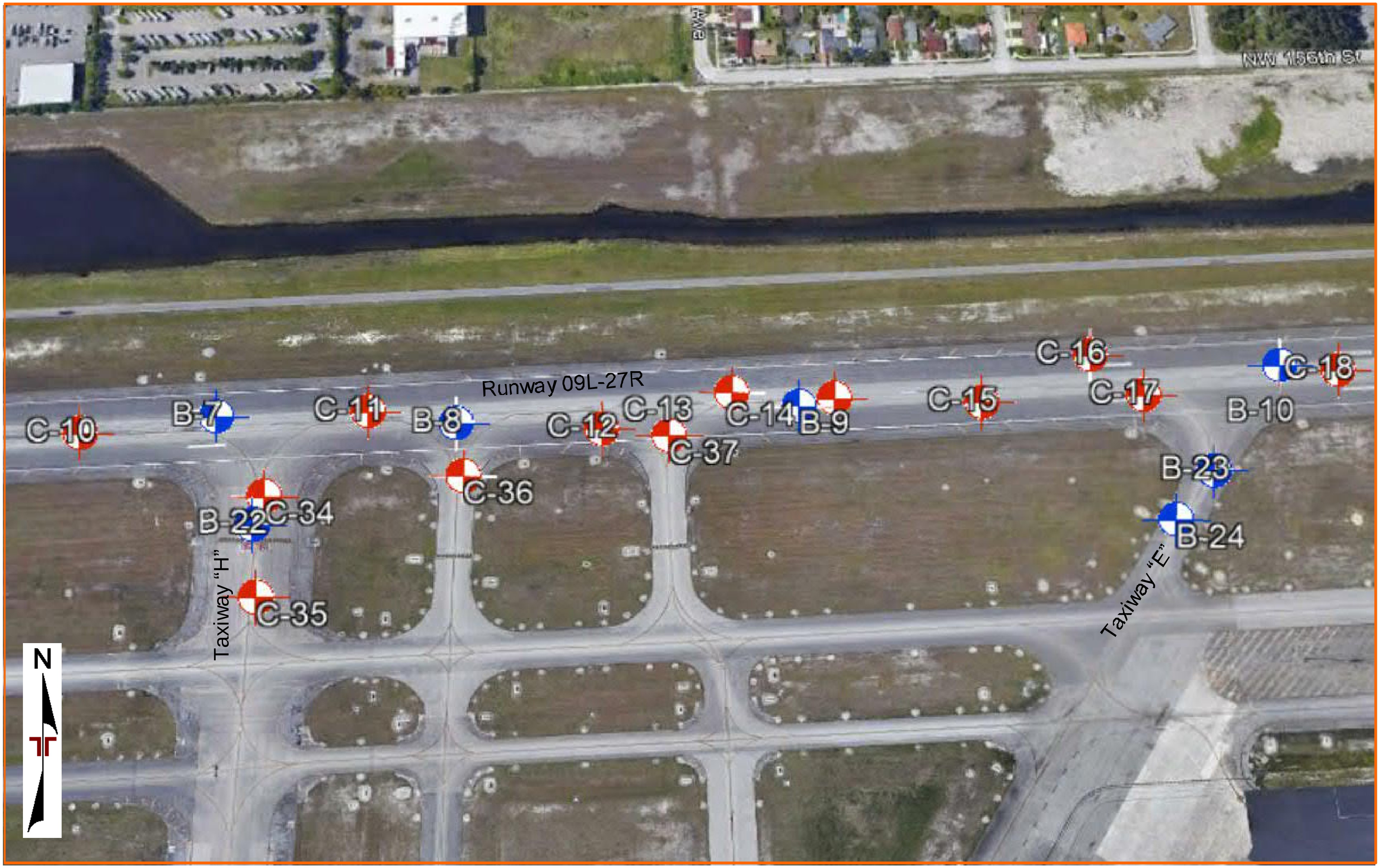
AERIAL PHOTOGRAPHY PROVIDED BY GOOGLE EARTH

EXPLORATION PLANS

Rehabilitation of OPF Runway 97-27R ■ Opa-Locka, FL
January 12, 2022 ■ Terracon Project No. H8205120



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AERIAL PHOTOGRAPHY PROVIDED BY GOOGLE EARTH

EXPLORATION PLANS

Rehabilitation of OPF Runway 97-27R ■ Opa-Locka, FL
January 12, 2022 ■ Terracon Project No. H8205120

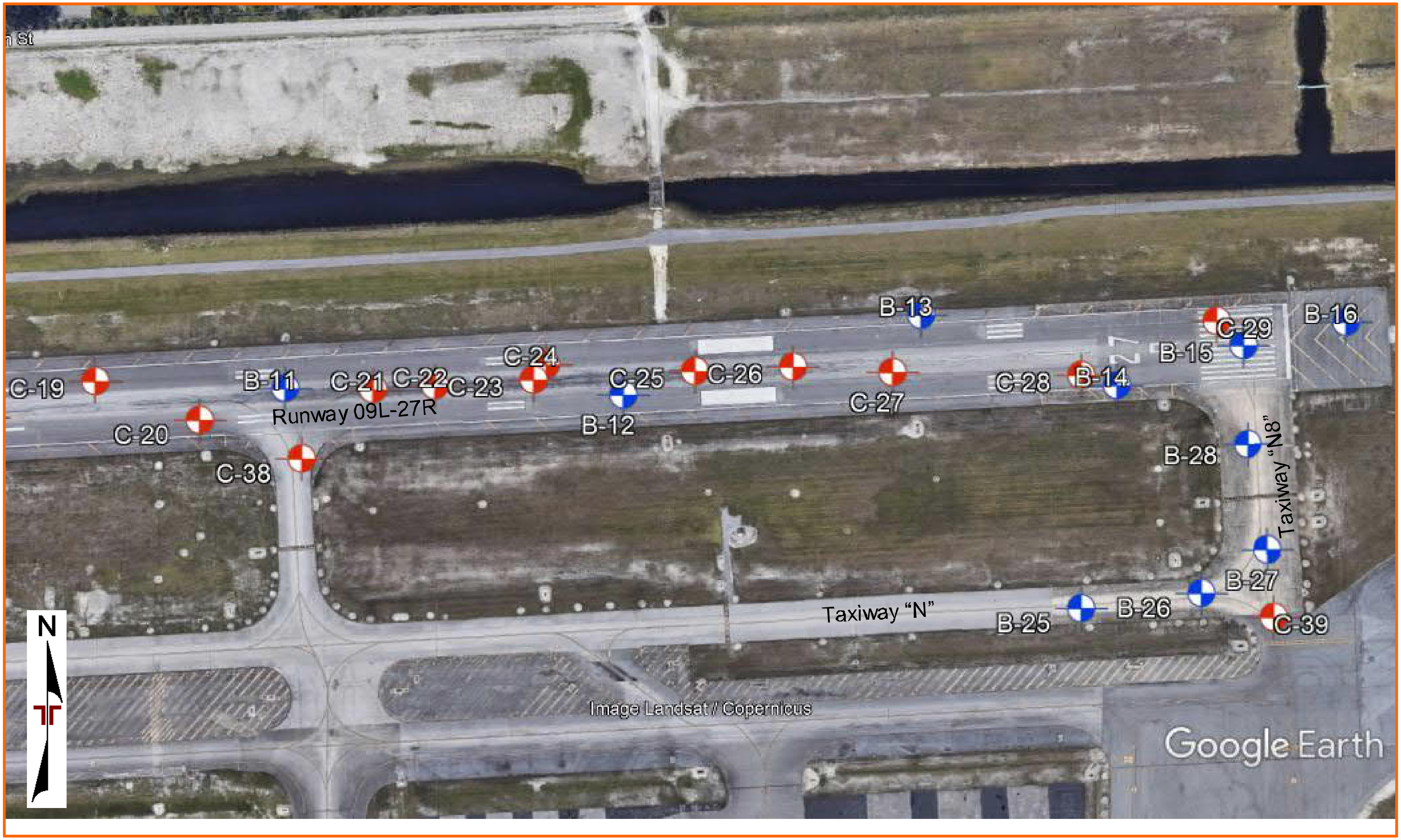


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY GOOGLE EARTH

EXPLORATION RESULTS

Boring Logs (28)
Dynamic Cone Penetrometer Field Reports (27)
Photolog of Pavement Cores (67)
Particle Size Distribution Reports (12)

BORING LOGS

BORING LOG NO. B-1

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.2	**ASPHALT**, (2" Thick)							
0.9	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)							
2.0	**FILL - FINE SAND (SP)**, brownish gray			X	10-12-12-10 N=24		6.4	3
4.2	**FINE SAND (SP)**, light brown			X	13-15-15-12 N=30			
9.2	**FINE SAND (SP)**, light brown to brown	5	▽	X	10-8-8-6 N=16			
				X	4-3-3-3 N=6			
10.2	**LIMESTONE**, with fine sand, light brown	10		X	3-3-7-7 N=10			
	Boring Terminated at 10.2 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS
▽ *Water Initially Encountered at 5.6'*

16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-14-2021	Boring Completed: 10-14-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-1

BORING LOG NO. B-2

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.5	**ASPHALT**, (5.5" Thick)							
	1.3	**CONCRETE**, (9.75" Thick)							
	3.3	**FILL - FINE SAND (SP)**, trace limerock, light brown and brown, (24" Thick)				8-8-10-13 N=18			
	8.3	**FINE SAND (SP)**, light brown	5			9-10-12-14 N=22			
				▽		8-6-5-4 N=11			
						3-3-4-4 N=7			
	11.3	**LIMESTONE**, with fine sand, light brown	10			5-5-7-8 N=12			
		Boring Terminated at 11.3 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.6'*

16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-08-2021	Boring Completed: 10-08-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-2

BORING LOG NO. B-3

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	ASPHALT, (8.75" Thick) 0.7							
	CONCRETE, (10" Thick) 1.6							
	FILL - FINE SAND (SP), with limerock, brown 3.6			X	1-15-15-13 N=30		13.0	4
	FINE SAND (SP), light brown	5		X	10-8-7-5 N=15			
	6.6		▽	X	3-4-4-5 N=8			
	LIMESTONE, with fine sand, light brown 9.6			X	8-10-12-12 N=22			
	Boring Terminated at 9.6 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.6'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-08-2021	Boring Completed: 10-08-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-3

BORING LOG NO. B-4

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.3	**ASPHALT**, (3.25" Thick)							
	0.9	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)				14-10-7-5 N=17			
	2.0	**FILL - FINE SAND (SP)**, with limerock, light brown and dark brown							
	4.3	**FILL - FINE SAND (SP)**, light gray and brown				6-5-4-4 N=9		6.7	3
	7.3	**FINE SAND (SP)**, light brown	5	▽		3-3-2-3 N=5			
	10.3	**LIMESTONE**, with fine sand, light brown	10			4-6-5-5 N=11; 7-7-8-8 N=15			

Boring Terminated at 10.3 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 5.5'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-08-2021	Boring Completed: 10-08-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-4

BORING LOG NO. B-5

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.8	**ASPHALT**, (9.75" Thick)							
1.5	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)			X	19-17-15-13 N=32			
2.8	**FILL - FINE SAND (SP)**, with limerock, light brown and brown							
5.8	**FINE SAND (SP)**, light brown and brown	5		X	10-12-12-13 N=24			
			▽	X	10-8-8-10 N=16			
8.8	**LIMESTONE**, with fine sand, light brown			X	7-5-5-4 N=10			

Boring Terminated at 8.8 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.5'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-08-2021	Boring Completed: 10-08-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-5

BORING LOG NO. B-6

PROJECT: Rehabilitation of OPF Runway 97-27R

**CLIENT: Atkins Global
Miami, FL**

**SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL**

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.8	**ASPHALT**, (9.625" Thick)							
	1.5	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)			X	28-20-17-17 N=37			
	2.8	**FILL - FINE SAND (SP)**, with limerock, light brown							
	7.8	**FINE SAND (SP)**, light brown to brown	5	▽	X	15-14-17-20 N=31; 6-4-4-3 N=8; 3-3-4-4 N=7			
	8.8	**SILTY FINE SAND (SM)**, with limestone lenses / layers, light brown							
	10.8	**LIMESTONE**, with fine sand, light brown	10		X	10-13-17-23 N=30			

Boring Terminated at 10.8 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.7'*

Notes:

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-08-2021	Boring Completed: 10-08-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL H8205120 REHABILITATION OF.GPJ TERRACON_DATATEMPLATE.GDT 12/6/21

BORING LOG NO. B-7

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.9	**ASPHALT**, (10.25" Thick)							
	1.5	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)							
	2.9	**FILL - FINE SAND (SP)**, with limerock, light brown to brown				27-25-20-22 N=45			
	4.9	**FINE SAND (SP)**, light brown to brown				18-15-13-15 N=28			
	6.9	**LIMESTONE**, with fine sand, light brown	5	▽		10-10-8-6 N=18			
		Boring Terminated at 6.9 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.9'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-7

BORING LOG NO. B-8

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	ASPHALT, (7.5" Thick) 0.6							
	FILL - LIMEROCK (GP), with fine sand, light brown, (8" Thick) 1.3				13-12-10-12 N=22			
	FILL - FINE SAND (SP), with limerock, light brown to brown 2.6							
	FINE SAND (SP), light gray and brown				12-12-12-13 N=24			
		5			9-5-3-3 N=8			
			▽		3-2-1-0 N=3			
	9.6				1-3-4-5 N=7			
	LIMESTONE, with fine sand, light brown 10.6	10						
	Boring Terminated at 10.6 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.7'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-8

BORING LOG NO. B-9

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	ASPHALT, (8" Thick) 0.7							
	FILL - LIMEROCK (GP), with fine sand, light brown, (8" Thick) 1.4			X	13-10-8-8 N=18			
	FILL - FINE SAND (SP), with limerock, brown 2.7							
	FILL - FINE SAND (SP), trace organic stains, slightly silty, brown to dark brown 3.7			X	6-6-5-6 N=11	0.7	2.7	
	FINE SAND (SP), light brown 6.7	5		X	4-3-2-3 N=5			
	LIMESTONE, with fine sand, light brown 8.7		▽	X	5-5-7-8 N=12			
	Boring Terminated at 8.7 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.9'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-9

BORING LOG NO. B-10

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.7	**ASPHALT**, (8" Thick)							
1.3	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)							
2.2	**FILL - FINE SAND (SP)**, with limerock, light brown				26-18-12-12 N=30			
2.7	**FILL - LIMEROCK (GP)**, with fine sand, light brown							
6.2	**FINE SAND (SP)**, light gray to brown	5			10-12-13-13 N=25; 5-5-6-6 N=11			
6.7	**LIMESTONE**, with fine sand, light brown							
	Boring Terminated at 6.7 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

Water No Encountered

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-10

BORING LOG NO. B-11

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global Miami, FL

SITE: Miami Opa-Locka Executive Airport Opa-Locka, FL

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.6	**ASPHALT**, (7.75" Thick)							
1.3	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)							
2.1	**FILL - FINE SAND (SP)**, with limerock, light brown			SPT	23-12-8-8 N=20			
5.6	**FINE SAND (SP)**, brown to light brown	5		SPT	6-6-5-5 N=11			
				SPT	4-3-2-3 N=5			
8.6	**LIMESTONE**, with fine sand, light brown		▽	SPT	3-3-4-4 N=7			

Boring Terminated at 8.6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.6'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-11

BORING LOG NO. B-12

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global Miami, FL

SITE: Miami Opa-Locka Executive Airport Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.6	**ASPHALT**, (6.75" Thick)							
	1.1	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)				20-16-14-19 N=30			
	2.6	**FILL - FINE SAND (SP)**, with limerock, light brown							
	5.6	**FINE SAND (SP)**, light brown to brown	5			10-12-12-13 N=24			
	6.6	**LIMESTONE**, with fine sand, light brown				8-6-5-5 N=11			

Boring Terminated at 6.6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

Water No Encountered

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-12

BORING LOG NO. B-13

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.2	**ASPHALT**, (2.75" Thick)							
0.9	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)							
1.7	**FILL - FINE SAND (SP)**, with limerock, brown				13-12-10-9 N=22			
2.2	**FINE SAND (SP)**, light brown							
6.2	**LIMESTONE**, with fine sand, light brown	5	▽		6-5-5-4 N=10; 4-3-4-4 N=7			

Boring Terminated at 6.2 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 5.5'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-06-2021	Boring Completed: 10-06-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-13

BORING LOG NO. B-14

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.2	**ASPHALT**, (2.25" Thick)							
	0.9	**CONCRETE**, (9.25" Thick)							
	2.9	**FILL - FINE SAND (SP)**, with limerock, brown to light brown, (24" Thick)				9-10-10-12 N=20			
	6.4	**FINE SAND (SP)**, light brown to brown	5	▽		10-9-8-8 N=17 6-4-3-3 N=7			
	8.9	**LIMESTONE**, with fine sand, light brown				5-7-8-8 N=15			

Boring Terminated at 8.9 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 5.5'*

Notes:

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-06-2021	Boring Completed: 10-06-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-14

BORING LOG NO. B-15

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	ASPHALT, (6.25" Thick) — 0.5							
	CONCRETE, (9.75" Thick) — 1.3							
	FILL - FINE SAND (SP), with limerock, brown, (8" Thick) — 2.0							
	FILL - FINE SAND (SP), with limerock, light brown to brown — 3.3				15-13-12-10 N=25		8.8	4
	FINE SAND (SP), light brown — 5.8	5			9-9-8-8 N=17			
	LIMESTONE, with fine sand, light brown — 7.3		▽		5-6-7-8 N=13			
	Boring Terminated at 7.3 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.9'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-06-2021	Boring Completed: 10-06-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-15

BORING LOG NO. B-16

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.1 **ASPHALT**, (1.75" Thick)							
	0.6 **FILL - LIMEROCK (GP)**, with fine sand, light brown, (6" Thick)							
	FINE SAND (SP), light brown and brown			X	25-12-8-8 N=20			
				X	8-8-8-7 N=16			
		5	▽	X	5-5-4-3 N=9			
	6.5 **LIMESTONE**, with fine sand, light brown			X	5-6-8-8 N=14			
	8.0 ***Boring Terminated at 8 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 5.5'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-06-2021	Boring Completed: 10-06-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-16

BORING LOG NO. B-17

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	CONCRETE, (10.25" Thick)							
	0.9 **FILL - FINE SAND (SP)**, with limerock, light brown and brown, (8" Thick)						15.1	4
	1.5 **FINE SAND (SP)**, light brown				11-10-8-6 N=18			
			▽		5-5-6-5 N=11			
	4.9 **LIMESTONE**, with fine sand, light brown	5			4-3-5-5 N=8			
	6.9 ***Boring Terminated at 6.9 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 4.7'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-13-2021	Boring Completed: 10-13-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-17

BORING LOG NO. B-18

PROJECT: Rehabilitation of OPF Runway 97-27R

**CLIENT: Atkins Global
Miami, FL**

**SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL**

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.8	**CONCRETE**, (10" Thick)							
1.4	**FILL - FINE SAND (SP)**, with limerock, brown, (7" Thick)			SPT	10-12-15-13 N=27		7.0	3
3.8	**FINE SAND (SP)**, brown to light brown			SPT	8-5-4-4 N=9			
6.8	**LIMESTONE**, with fine sand, light brown	5	▽	SPT	7-7-8-8 N=15			
	Boring Terminated at 6.8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 4.5'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-14-2021 | Boring Completed: 10-14-2021

Drill Rig: CME-75 | Driller: OC

Project No.: H8205120 | Exhibit: A-18

BORING LOG NO. B-19

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG / DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.9	**CONCRETE**, (10.25" Thick)							
1.4	**FILL - FINE SAND (SP)**, trace to with limerock, brown, (7" Thick)			X	10-12-12-10 N=24		14.8	4
6.9	**FINE SAND (SP)**, brown to light brown		▽	X	6-4-3-1 N=7			
		5		X	1-0-1-2 N=1			
8.9	**LIMESTONE**, with fine sand, light brown			X	5-7-7-8 N=14			
	Boring Terminated at 8.9 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 4.3'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-14-2021	Boring Completed: 10-14-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-19

BORING LOG NO. B-20

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.8	**CONCRETE**, (9.75" Thick)							
	1.5	**FILL - FINE SAND (SP)**, with limerock, brown, (8" Thick)			X	10-12-12-10 N=24	1.0	8.9	3
	10.8	**FINE SAND (SP)**, light brown		▽	X	8-7-5-3 N=12			
			5		X	2-1-1-2 N=2			
					X	2-1-1-2 N=2			
			10		X	2-2-2-2 N=4			
		Boring Terminated at 10.8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 3.6'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-14-2021	Boring Completed: 10-14-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-20

BORING LOG NO. B-21

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.2 **ASPHALT**, (2.25" Thick)							
	1.0 **CONCRETE**, (9.75" Thick)							
	1.8 **FILL - FINE SAND (SP)**, with limerock, brown, (9" Thick)			X	8-10-12-12 N=22		12.9	2
	8.0 **FINE SAND (SP)**, brown to light brown	5	▽	X	7-6-6-5 N=12			
				X	3-2-2-2 N=4			
				X	3-4-5-7 N=9			
	9.0 **LIMESTONE**, with fine sand, light brown							
	Boring Terminated at 9 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 5.1'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-14-2021	Boring Completed: 10-14-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-21

BORING LOG NO. B-22

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.3	**ASPHALT**, (3.25" Thick)							
	0.9	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)				11-10-8-7 N=18			
	2.3	**FILL - LIMEROCK (GP)**, with silty fine sand, light brown and brown							
	6.3	**FINE SAND (SP)**, light brown	5	▽		5-6-5-5 N=11 4-3-2-3 N=5			
	8.3	**LIMESTONE**, with fine sand, light brown				5-7-8-8 N=15			
		Boring Terminated at 8.3 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.2'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-13-2021	Boring Completed: 10-13-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-22

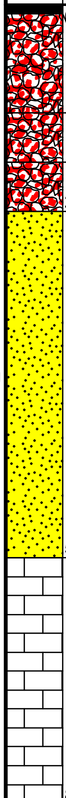
BORING LOG NO. B-23

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan



DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.1	**ASPHALT**, (1.375" Thick)							
1.1	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (12" Thick)			X	36-32-22-16 N=54			
1.6	**FILL - FINE SAND (SP)**, with limerock, brown							
2.1	**FILL - LIMEROCK (GP)**, with fine sand, light brown							
	FINE SAND (SP), light brown			X	8-5-5-4 N=10			
5.6		5	▽	X	3-3-2-5 N=5			
8.1	**LIMESTONE**, with fine sand, light brown			X	2-13-15-25 N=28			

Boring Terminated at 8.1 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 4.9'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-07-2021	Boring Completed: 10-07-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-23

BORING LOG NO. B-24

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.1	**ASPHALT**, (1.375" Thick)							
0.9	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (8" Thick)							
2.1	**FILL - FINE SAND (SP)**, with limerock, light brown			SPT	38-33-22-20 N=55			
5.6	**LIMESTONE**, with fine sand, light brown	5		SPT	20-10-14-10 N=24; 10-8-5-4 N=13			
7.6	**FINE SAND (SP)**, brown		▽	SPT	3-5-7-8 N=12			
8.0	**LIMESTONE**, with fine sand, light brown							

Boring Terminated at 8 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.0'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-13-2021	Boring Completed: 10-13-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-24

BORING LOG NO. B-25

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.8 **CONCRETE**, (9.75" Thick)							
	1.5 **FILL - FINE SAND (SP)**, with limerock, brownish gray, (8" Thick)			X	7-6-5-6 N=11		11.5	4
	6.8 **FINE SAND (SP)**, light brown			X	6-5-6-5 N=11			
		5	∇	X	5-5-4-3 N=9			
	8.8 **LIMESTONE**, with fine sand, light brown			X	7-7-6-7 N=13			
	Boring Terminated at 8.8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

∇ *Water Initially Encountered at 6.0'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-13-2021	Boring Completed: 10-13-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-25

BORING LOG NO. B-26

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

GRAPHIC LOG	LOCATION See Exploration Plan DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	CONCRETE, (10" Thick) 0.8							
	FINE SAND (SP), light gray and brown			X	7-5-6-6 N=11		12.0	3
	4.8			X	5-6-3-3 N=9			
	LIMESTONE, with fine sand, light brown 6.8	5	▽	X	3-3-4-3 N=7			
	Boring Terminated at 6.8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.1'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-13-2021	Boring Completed: 10-13-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-26

BORING LOG NO. B-27

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
	0.9	**CONCRETE**, (10.25" Thick)							
	1.2	**FILL - LIMEROCK (GP)**, with fine sand, light brown, (3" Thick)							
	2.9	**FINE SAND (SP)**, brown to light brown			X	10-8-7-8 N=15			
	6.9	**LIMESTONE**, with fine sand, light brown	5	▽	X	6-7-8-8 N=15			
					X	9-7-6-6 N=13			
		Boring Terminated at 6.9 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 6.2'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-13-2021	Boring Completed: 10-13-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-27

BORING LOG NO. B-28

PROJECT: Rehabilitation of OPF Runway 97-27R

CLIENT: Atkins Global
Miami, FL

SITE: Miami Opa-Locka Executive Airport
Opa-Locka, FL

LOCATION See Exploration Plan

GRAPHIC LOG DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ORGANIC CONTENT (%)	WATER CONTENT (%)	PERCENT FINES
0.8	**CONCRETE**, (9.5" Thick)							
2.3	**FILL - FINE SAND (SP)**, with limerock, light brown, (18" Thick)				8-8-10-9 N=18			
3.8	**FINE SAND (SP)**, light brown				6-5-5-4 N=10			
7.8	**FINE SAND (SP)**, slightly silty, light brown	5	▽		3-2-1-2 N=3			
8.8	**LIMESTONE**, with fine sand, light brown				2-2-3-4 N=5			
	Boring Terminated at 8.8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Standard Penetration Test "SPT"

Abandonment Method:
Boring backfilled with concrete mix upon completion

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water Initially Encountered at 5.9'*

Terracon
16200 NW 59th Ave Ste 106
Miami Lakes, FL

Boring Started: 10-06-2021	Boring Completed: 10-06-2021
Drill Rig: CME-75	Driller: OC
Project No.: H8205120	Exhibit: A-28

DYNAMIC CONE PENETROMETER

FIELD REPORTS

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-1 (B-1)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	Date: 10/14/2021

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.17	0	2	Asphalt (2 inches)						
0.17	0.83	2	10	Limerock with Fine Sand (8 inches)						
0.83	1.33	10	16	See boring log for soil description	15	152.4	10.2	1.0	10.2	20
1.33	1.83	16	22		30	152.4	5.1	1.0	5.1	49
1.83	2.33	22	28		42	152.4	3.6	1.0	3.6	68
2.33	2.83	28	34		37	152.4	4.1	1.0	4.1	59
2.83	3.33	34	40		37	152.4	4.1	1.0	4.1	59
3.33	3.50	40	42		10	50.8	5.1	1.0	5.1	49

Groundwater Depth: Encountered at 5 feet 7 inches in Boring B-1	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-2 (B-2)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/8/2021

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.46	0	5.5	Asphalt (5.5 inches)						
0.46	1.27	5.5	15.25	Concrete (9.75 inches)						
1.27	1.94	15.25	23.25	Fine Sand, trace limerock (8 inches)						
1.94	2.44	23.25	29.25	See boring log for soil description	25	152.4	6.1	1.0	6.1	39.5
2.44	2.77	29.25	33.25		20	101.6	5.1	1.0	5.1	49.0

Groundwater Depth: Encountered at 6 feet 7 inches in Boring B-2	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-3 (B-3)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/8/2021

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.73	0	8.75	Asphalt (8.75 inches)						
0.73	1.56	8.75	18.75	Concrete (10 inches)						
1.56	2.06	18.75	24.75	Fine sand with limerock (6 inches)						
2.06	2.56	24.75	30.75	See boring log for soil description	31	152.4	4.9	1.0	4.9	51.0
2.56	3.06	30.75	36.75		48	152.4	3.2	1.0	3.2	76.0

Groundwater Depth: Encountered at 6 feet 7 inches in Boring B-3	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-4 (B-4)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/8/2021

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.27	0	3.25	Asphalt (3.25 inches)						
0.27	0.94	3.25	11.25	Limerock with fine sand (8 inches)						
0.94	1.44	11.25	17.25	See boring log for soil description	34	152.4	4.5	1.0	4.5	55.0
1.44	1.94	17.25	23.25		25	152.4	6.1	1.0	6.1	39.5
1.94	2.44	23.25	29.25		16	152.4	9.5	1.0	9.5	22.5
2.44	2.94	29.25	35.25		9	152.4	16.9	1.0	16.9	12.1

Groundwater Depth: Encountered at 5 feet 6 inches in Boring B-4	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-5 (B-5)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/8/2021

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.81	0	9.75	Asphalt (9.75 inches)						
0.81	1.48	9.75	17.75	Limerock with fine sand (8 inches)						
1.48	1.98	17.75	23.75	See boring log for soil description	70	152.4	2.2	1.0	2.2	100.0
1.98	2.31	23.75	27.75		48	101.6	2.1	1.0	2.1	100.0

Groundwater Depth: Encountered at 6 feet 6 inches in Boring B-5	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-6 (B-6)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021	

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.80	0	9.625	Asphalt (9.625 inches)						
0.80	1.47	9.625	17.63	Limerock with fine sand (8 inches)						
1.47	1.97	17.63	23.63	See boring log for soil description	48	152.4	3.2	1.0	3.2	76.0
1.97	2.47	23.63	29.63		46	152.4	3.3	1.0	3.3	74.0
2.47	2.80	29.63	33.63		47	101.6	2.2	1.0	2.2	100.0

Groundwater Depth: Encountered at 6 feet 8 inches in Boring B-6	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-7 (B-7)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.85	0	10.25	Asphalt (10.25 inches)						
0.85	1.52	10.25	18.25	Limerock with fine sand (8 inches)						
1.52	2.02	18.25	24.25	See boring log for soil description	56	152.4	2.7	1.0	2.7	100.0
2.02	2.52	24.25	30.25		72	152.4	2.1	1.0	2.1	100.0

Groundwater Depth: Encountered at 7 feet in Boring B-7	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-8 (B-8)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021	

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.63	0	7.5	Asphalt (7.5 inches)						
0.63	1.29	7.5	15.5	Limerock with fine sand (8 inches)						
1.29	1.79	15.5	21.5	See boring log for soil description	39	152.4	3.9	1.0	3.9	62.0
1.79	2.29	21.5	27.5		60	152.4	2.5	1.0	2.5	100.0
2.29	2.79	27.5	33.5		54	152.4	2.8	1.0	2.8	100.0

Groundwater Depth: Encountered at 6 feet 8 inches in Boring B-8	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-9 (B-9)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.67	0	8	Asphalt (8 inches)						
0.67	1.33	8	16	Limerock with fine sand (8 inches)						
1.33	1.83	16	22	See boring log for soil description	25	152.4	6.1	1.0	6.1	39.5
1.83	2.33	22	28		17	152.4	9.0	1.0	9.0	25.0
2.33	2.83	28	34		27	152.4	5.6	1.0	5.6	44.0

Groundwater Depth: Encountered at 6 feet 10 inches in Boring B-9	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-10 (B-10)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.67	0	8	Asphalt (8 inches)						
0.67	1.33	8	16	Limerock with fine sand (8 inches)						
1.33	1.83	16	22	See boring log for soil description	38	152.4	4.0	1.0	4.0	60.0
1.83	2.33	22	28		44	152.4	3.5	1.0	3.5	70.0
2.33	2.50	28	30		22	50.8	2.3	1.0	2.3	100.0

Groundwater Depth: Not encountered in Boring B-10	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-11 (B-11)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.65	0	7.75	Asphalt (7.75 inches)						
0.65	1.31	7.75	15.75	Limerock with fine sand (8 inches)						
1.33	1.83	16	22	See boring log for soil description	28	152.4	5.4	1.0	5.4	46.0
1.83	2.33	22	28		22	152.4	6.9	1.0	6.9	35.5
2.33	2.83	28	34		30	152.4	5.1	1.0	5.1	49.0
2.83	3.00	34	36		12	50.8	4.2	1.0	4.2	58.0

Groundwater Depth: Encountered at 6 feet 7 inches in Boring B-11	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer
Field Report (ASTM D6951)

DCP BORING NO. DCP-12 (B-12)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.56	0	6.75	Asphalt (6.75 inches)						
0.56	1.23	6.75	14.75	Limerock with fine sand (8 inches)						
1.23	1.73	14.75	20.75	See boring log for soil description	25	152.4	6.1	1.0	6.1	39.5
1.73	2.23	20.75	26.75		37	152.4	4.1	1.0	4.1	59.0
2.23	2.73	26.75	32.75		30	152.4	5.1	1.0	5.1	49.0
2.73	2.90	32.75	34.75		10	50.8	5.1	1.0	5.1	49.0

Groundwater Depth: Not encountered in Boring B-12	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-13 (B-13)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/7/2021

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.23	0	2.75	Asphalt (2.75 inches)						
0.23	0.90	2.75	10.75	Limerock with fine sand (8 inches)						
0.90	1.40	10.75	16.75	See boring log for soil description	22	152.4	6.9	1.0	6.9	35.5
1.40	1.90	16.75	22.75		24	152.4	6.4	1.0	6.4	38.0
1.90	2.40	22.75	28.75		22	152.4	6.9	1.0	6.9	35.5
2.40	2.90	28.75	34.75		14	152.4	10.9	1.0	10.9	20.0
2.90	3.06	34.75	36.75		3	50.8	16.9	1.0	16.9	12.1

Groundwater Depth: Encountered at 5 feet 6 inches in Boring B-13	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-14 (B-14)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/6/2021	

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.19	0	2.25	Asphalt (2.25 inches)						
0.19	0.96	2.25	11.5	Concrete (9.25 inches)						
0.96	1.46	11.5	17.5	See boring log for soil description	32	152.4	4.8	1.0	4.8	52.0
1.46	1.96	17.5	23.5		25	152.4	6.1	1.0	6.1	39.5
1.96	2.46	23.5	29.5		34	152.4	4.5	1.0	4.5	55.0
2.46	2.79	29.5	33.5		23	101.6	4.4	1.0	4.4	56.0

Groundwater Depth: Encountered at 5 feet 6 inches in Boring B-14	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-15 (B-15)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/6/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.52	0	6.25	Asphalt (6.25 inches)						
0.52	1.33	6.25	16	Concrete (9.75 inches)						
1.33	2.00	16	24	Fine Sand with Limerock (8 inches)						
2.00	2.50	24	30	See boring log for soil description	36	152.4	4.2	1.0	4.2	58.0
2.50	2.83	30	34		37	101.6	2.7	1.0	2.7	100.0

Groundwater Depth: Encountered at 6 feet 10 inches in Boring B-15	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-16 (B-16)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/6/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.15	0	1.75	Asphalt (1.75 inches)						
0.15	0.65	1.75	7.75	Limerock with fine sand (6 inches)						
0.65	1.15	7.75	13.75	See boring log for soil description	33	152.4	4.6	1.0	4.6	54.0
1.15	1.65	13.75	19.75		21	152.4	7.3	1.0	7.3	33.5
1.65	2.15	19.75	25.75		22	152.4	6.9	1.0	6.9	35.5
2.15	2.65	25.75	31.75		27	152.4	5.6	1.0	5.6	43.0
2.65	2.98	31.75	35.75		15	101.6	6.8	1.0	6.8	36.0

Groundwater Depth: Encountered at 5 feet 6 inches in Boring B-16	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-17 (B-17)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021	

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.85	0	10.25	Concrete (10.25 inches)						
0.85	1.52	10.25	18.25	Fine Sand (8 inches)						
1.52	2.02	18.25	24.25	See boring log for soil description	21	152.4	7.3	1.0	7.3	33.5
2.02	2.52	24.25	30.25		35	152.4	4.4	1.0	4.4	56.0
2.52	2.85	30.25	34.25		18	101.6	5.6	1.0	5.6	44.0

Groundwater Depth: Encountered at 4 feet 8 inches in Boring B-17	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-18 (B-18)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.83	0	10	Concrete (10 inches)						
0.83	1.33	10	16	See boring log for soil description	28	152.4	5.4	1.0	5.4	46.0
1.33	1.83	16	22		49	152.4	3.1	1.0	3.1	78.0
1.83	2.33	22	28		39	152.4	3.9	1.0	3.9	62.0
2.33	2.83	28	34		26	152.4	5.9	1.0	5.9	41.0

Groundwater Depth: Encountered at 4 feet 6 inches in Boring B-18	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-19 (B-19)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/14/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.85	0	10.25	Concrete (10.25 inches)						
0.85	1.35	10.25	16.25	See boring log for soil description	49	152.4	3.1	1.0	3.1	78.0
1.35	1.85	16.25	22.25		50	152.4	3.0	1.0	3.0	80.0
1.85	2.35	22.25	28.25		27	152.4	5.6	1.0	5.6	44.0
2.35	2.85	28.25	34.25		19	152.4	8.0	1.0	8.0	30.0

Groundwater Depth: Encountered at 4 feet 3 inches in Boring B-19	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-20 (B-20)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/14/2021

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.81	0	9.75	Concrete (9.75 inches)						
0.81	1.31	9.75	15.75	See boring log for soil description	45	152.4	3.4	1.0	3.4	72.0
1.31	1.81	15.75	21.75		46	152.4	3.3	1.0	3.3	74.0
1.81	2.31	21.75	27.75		38	152.4	4.0	1.0	4.0	60.0
2.31	2.81	27.75	33.75		27	152.4	5.6	1.0	5.6	44.0
2.81	2.98	33.75	35.75		7	50.8	7.3	1.0	7.3	33.5

Groundwater Depth: Encountered at 3 feet 7 inches in Boring B-20	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-21 (B-21)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/14/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.19	0	2.25	Asphalt (2.25 inches)						
0.19	1.00	2.25	12	Concrete (9.75 inches)						
1.00	1.50	12	18	See boring log for soil description	27	152.4	5.6	1.0	5.6	44.0
1.50	2.00	18	24		42	152.4	3.6	1.0	3.6	68.0
2.00	2.50	24	30		33	152.4	4.6	1.0	4.6	54.0
2.50	2.83	30	34		19	101.6	5.3	1.0	5.3	47.0

Groundwater Depth: Encountered at 5 feet 1 inches in Boring B-21	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-22 (B-22)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.27	0	3.25	Asphalt (3.25 inches)						
0.27	0.94	3.25	11.25	Limerock with fine sand (8 inches)						
0.94	1.44	11.25	17.25	See boring log for soil description	19	152.4	8.0	1.0	8.0	30.0
1.44	1.94	17.25	23.25		35	152.4	4.4	1.0	4.4	56.0
1.94	2.44	23.25	29.25		19	152.4	8.0	1.0	8.0	30.0
2.44	2.94	29.25	35.25		22	152.4	6.9	1.0	6.9	35.5

Groundwater Depth: Encountered at 6 feet 2 inches in Boring B-22	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-24 (B-24)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021	

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.11	0	1.375	Asphalt (1.375 inches)						
0.11	0.78	1.375	9.375	Limerock with fine sand (8 inches)						
0.78	1.11	9.375	13.375	See boring log for soil description	58	152.4	2.6	1.0	2.6	100.0

Groundwater Depth: Encountered at 6 feet in Boring B-24	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-25 (B-25)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021

Stratigraphy					DCP Data					
From (ft)	To (ft)	From (in)	To (in)	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
0.00	0.81	0	9.75	Concrete (9.75 inches)						
0.81	1.48	9.75	17.75	Fine sand with limerock (8 inches)						
1.48	1.98	17.75	23.75	See boring log for soil description	15	152.4	10.2	1.0	10.2	20.0
1.98	2.48	23.75	29.75		25	152.4	6.1	1.0	6.1	39.5
2.48	2.65	29.75	31.75		9	50.8	5.6	1.0	5.6	44.0

Groundwater Depth: Encountered at 6 feet in Boring B-25	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Dynamic Cone Penetrometer
Field Report (ASTM D6951)

DCP BORING NO. DCP-26 (B-26)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.83	0	10	Concrete (10 inches)						
0.83	1.50	10	18	Fine sand (8 inches)						
1.50	2.00	18	24	See boring log for soil description	10	152.4	15.2	1.0	15.2	13.8
2.00	2.50	24	30		18	152.4	8.5	1.0	8.5	27.5
2.50	3.00	30	36		18	152.4	8.5	1.0	8.5	27.5

Groundwater Depth: Encountered at 6 feet 1 inch in Boring B-26	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-27 (B-27)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport
Project Name: Reabilitation of OPF Runway 9L/27R	10/13/2021

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.83	0	10	Concrete (10.25 inches)						
0.83	1.08	10	13	Limerock with fine sand (3 inches)						
1.08	1.58	13	19	See boring log for soil description	22	152.4	6.9	1.0	6.9	35.5
1.58	2.08	19	25		33	152.4	4.6	1.0	4.6	54.0
2.08	2.25	25	27		8	50.8	6.4	1.0	6.4	38.0

Groundwater Depth: Encountered at 6 feet 2 inch in Boring B-27

Advancement Method: DCP

Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer

Test By: OC

Reviewed By: HES

Terracon

Dynamic Cone Penetrometer Field Report (ASTM D6951)

DCP BORING NO. DCP-28 (B-28)

Project No.: H8205120	Location: Miami Opa-Locka Executive Airport	
Project Name: Reabilitation of OPF Runway 9L/27R	10/6/2021	

Stratigraphy					DCP Data					
From	To	From	To	Material Description	Accum. No. of Blows	Accum. Pen. (mm)	Pen. Per Blow (mm/blow)	Hammer Blow Factor	DCP Index (mm/Blow)	CBR* (%)
(ft)		(in)								
0.00	0.79	0	9.5	Concrete (9.5 inches)						
0.79	1.46	9.5	17.5	Fine sand with limerock (8 inches)						
1.46	1.96	17.5	23.5	See boring log for soil description	27	152.4	5.6	1.0	5.6	44.0
1.96	2.46	23.5	29.5		31	152.4	4.9	1.0	4.9	51.0
2.46	2.96	29.5	35.5		28	152.4	5.4	1.0	5.4	46.0
2.96	3.46	35.5	41.5		23	152.4	6.6	1.0	6.6	37.0
3.46	3.63	41.5	43.5		6	50.8	8.5	1.0	8.5	27.5

Groundwater Depth: Encountered at 5 feet 10 inch in Boring B-28	Advancement Method: DCP	Other Notes: Dynamic Cone Penetrometer with a Dual Mass Hammer
Test By: OC	Reviewed By: HES	

PHOTOGRAPHS OF PAVEMENT CORES

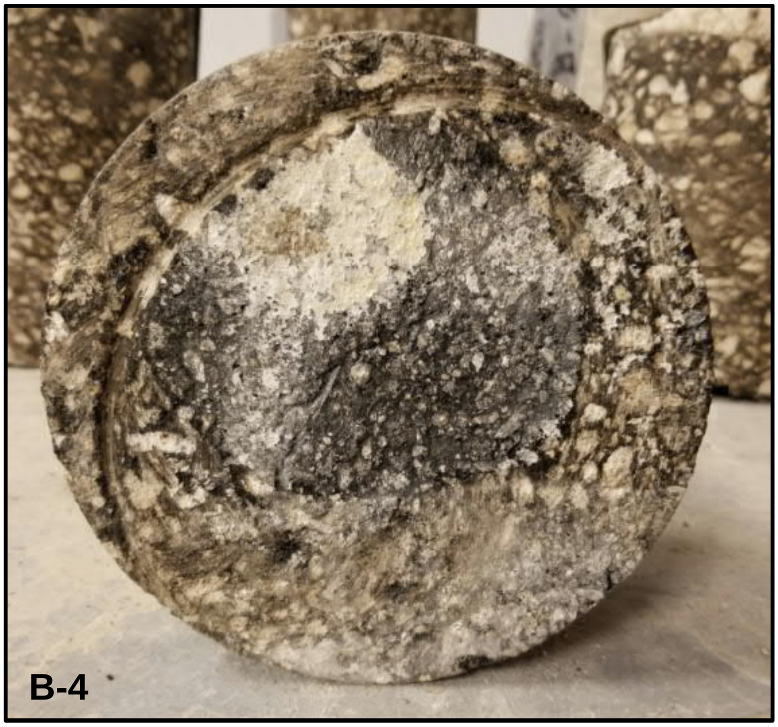
AT EACH BORING LOCATION

B-1 TO B-28

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-1	2.0	2.0

PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-2	5.5	9.75	15.25	9.5 and 9.75	0.25

PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-3	8.75	10.0	18.75	11.625 and 11.875	0.25



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-4	3.25	3.25

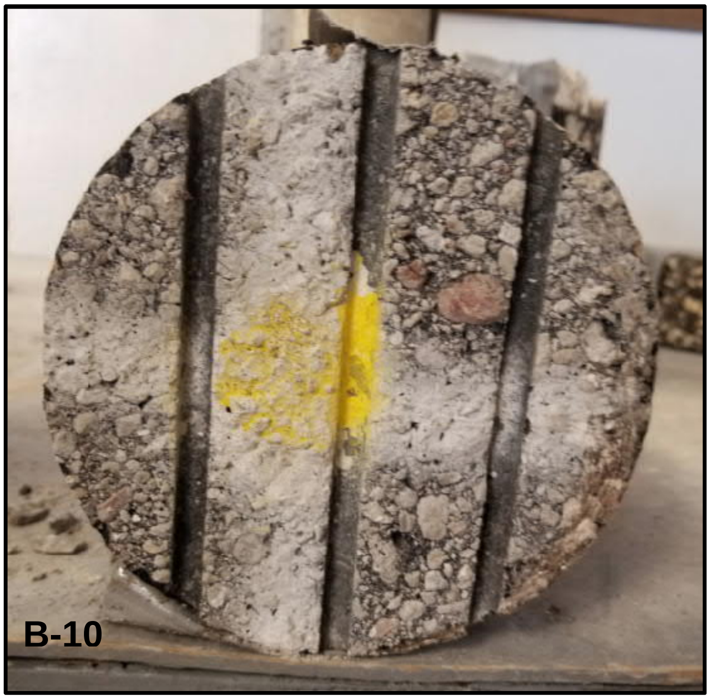
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
B-5	9.75	9.75	1.75

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-6	9.625	9.625

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-7	10.25	10.25

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
B-8	7.5	7.5	2.375

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-9	8.0	8.0



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-10	8.0	8.0

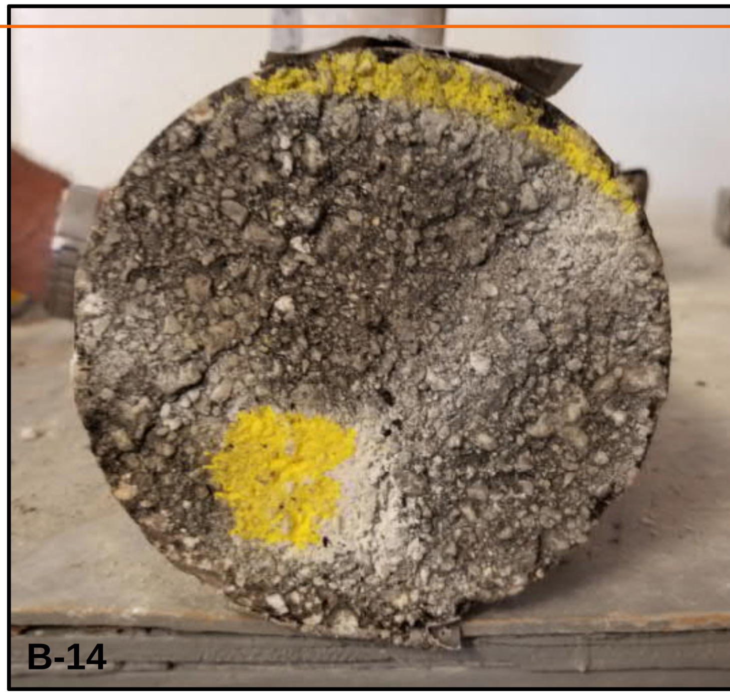
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-11	7.75	7.75

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-12	6.75	6.75

B-13

B-13

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-13	2.75	2.75

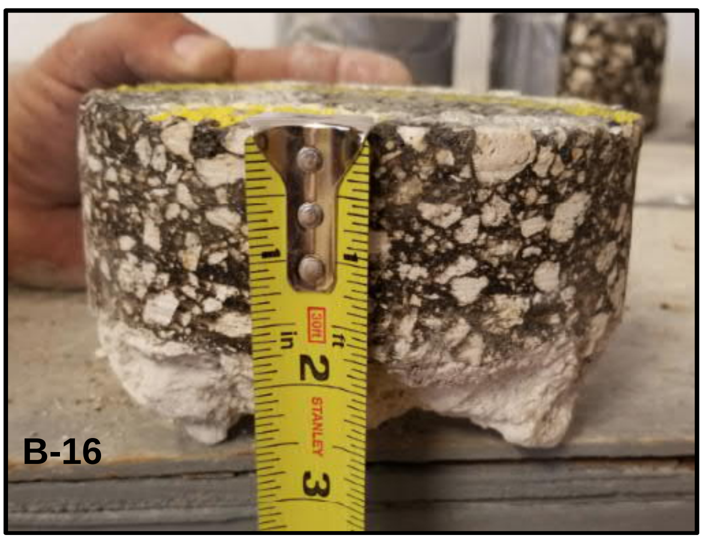


PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-14	2.25	9.25	11.5	3.25	0.25

PHOTOGRAPH OF PAVEMENT CORES

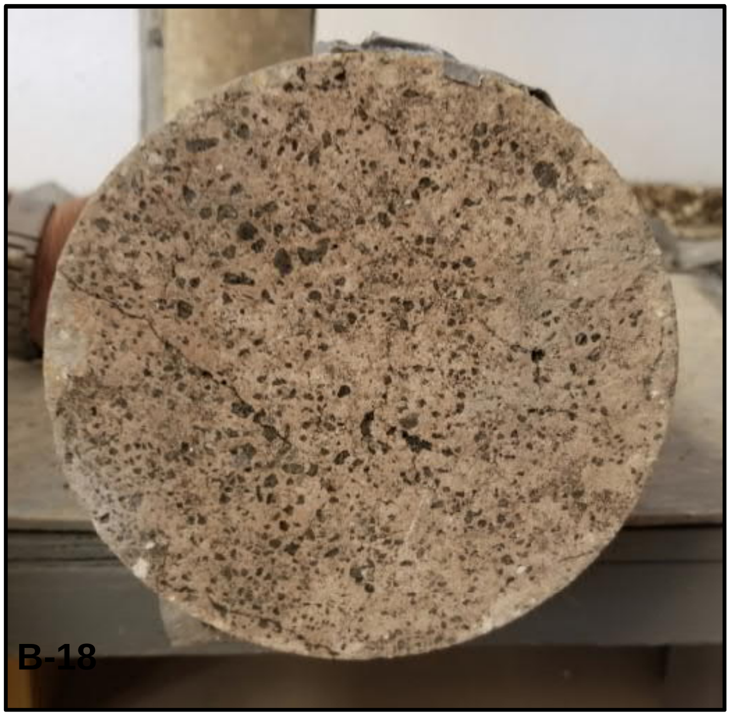
Miami Opa-Locka Executive Airport – Rehabilitation of OPF Runway 97-27R
Opa-Locka, Florida ■ January 12, 2022 ■ Terracon Project No. H8205120

PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-15	6.25	9.75	16.0	8.75	0.25

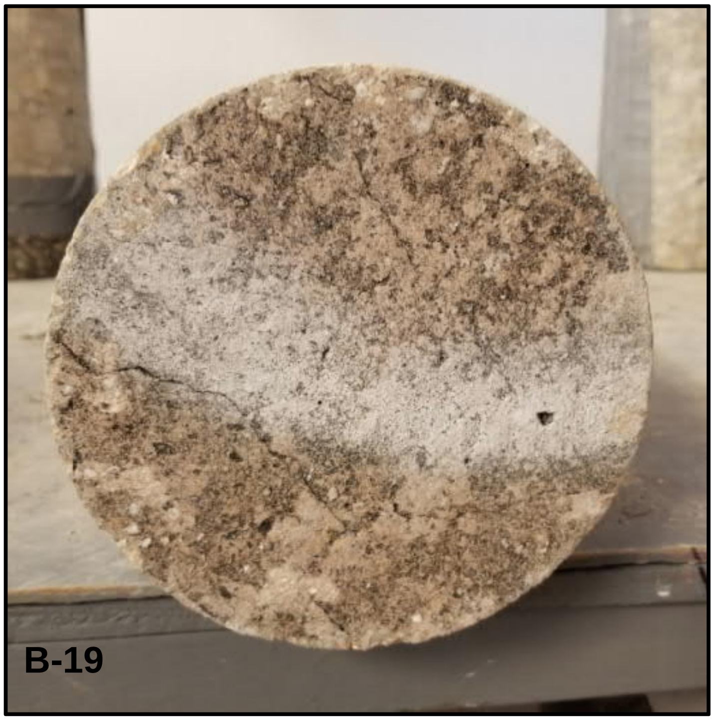


PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-16	1.75	1.75

PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-17	10.25	10.25	4.375	0.25



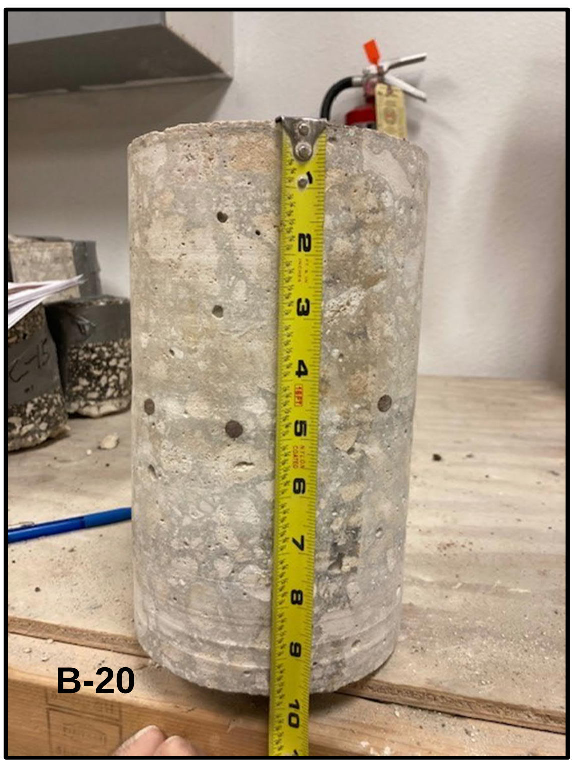
PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-18	10.0	10.0	3.0 and 3.25	0.25



PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-19	10.25	10.25	5.0	0.25

PHOTOGRAPH OF PAVEMENT CORES

Miami Opa-Locka Executive Airport – Rehabilitation of OPF Runway 97-27R
Opa-Locka, Florida ■ January 12, 2022 ■ Terracon Project No. H8205120

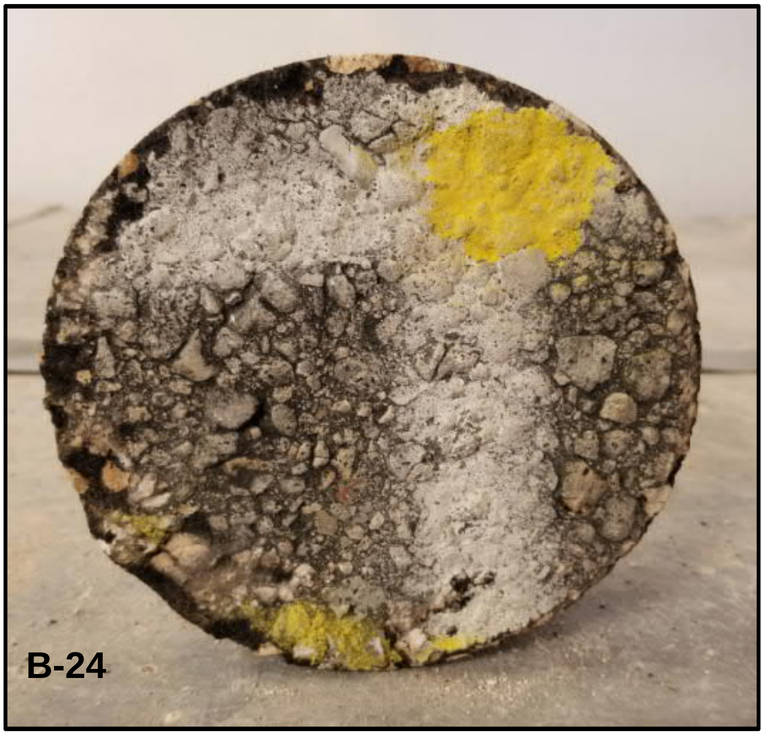


PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-20	9.75	9.75	4.625 and 5.0	0.25

PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-21	2.25	9.75	12.0	6.25 to 6.375	0.25

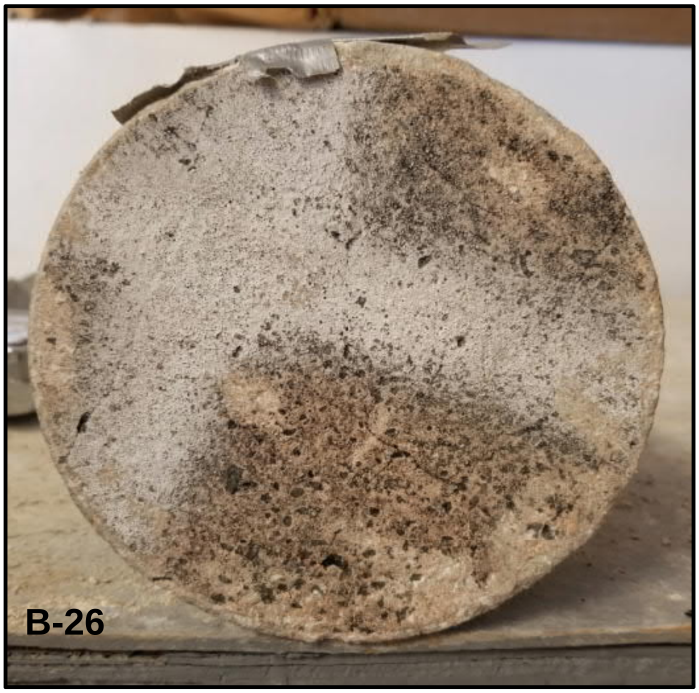
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-22	3.25	3.25

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-23	1.375	1.375



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
B-24	1.375	1.375

PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-25	9.75	9.75	4.125 and 4.5	0.25



PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-26	10.0	10.0	4.25	0.25 to 0.375

PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-27	10.25	10.25	4.75	0.25

PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
B-28	9.5	9.5	3.375	0.25

PHOTOGRAPH PAVEMENT CORES AT

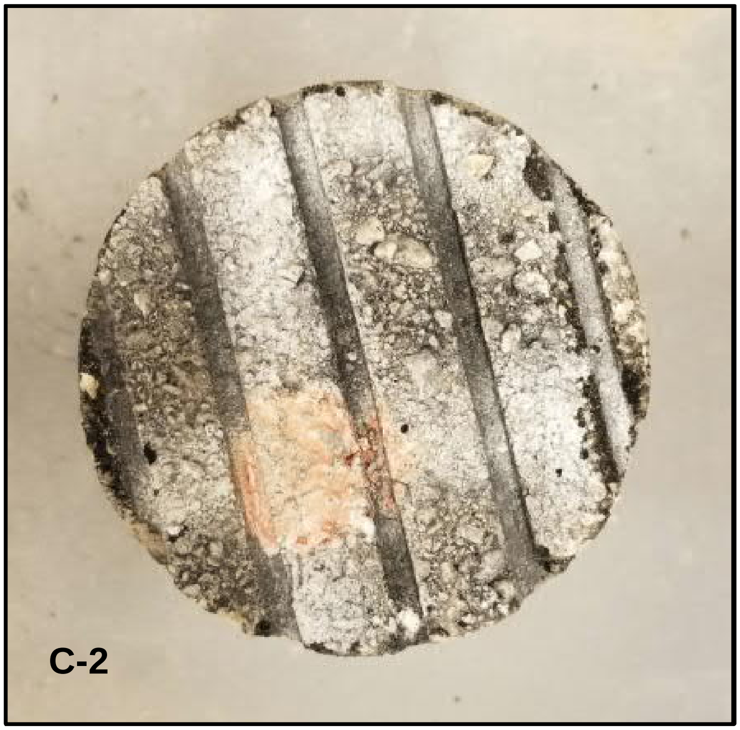
EACH BORING LOCATION

C-1 TO C-39

C-1

C-1

PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
C-1	6.5	9.5	16.0	6.5 to 16	9.375 and 11.75	0.25



PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
C-2	6.25	9.25	15.5	9.375 and 11.75	0.25, 0.375, and 1.25

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-3	11.0	11.0	1.75

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-4	6.125	6.125	0.75

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-5	10.875	10.875	2.0

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-6	8.25	8.25	3.5

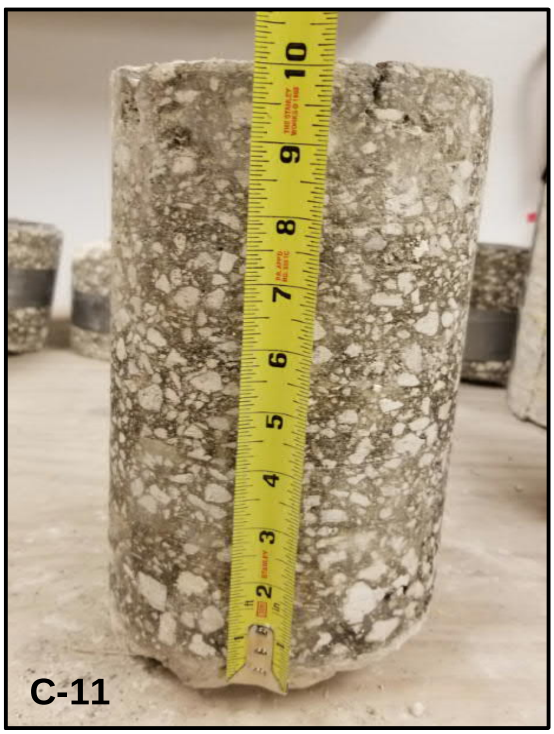
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-7	9.875	9.875	0.625

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-8	6.25	6.25	0.5

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-9	6.875	6.875	0.25

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-10	10.5	10.5	1.0

* Fracture shown near the bottom of core was a result of the core extraction and not debonding of the asphalt itself.



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-11	9.875	9.875	0.5

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-12	5.75	5.75	0.75

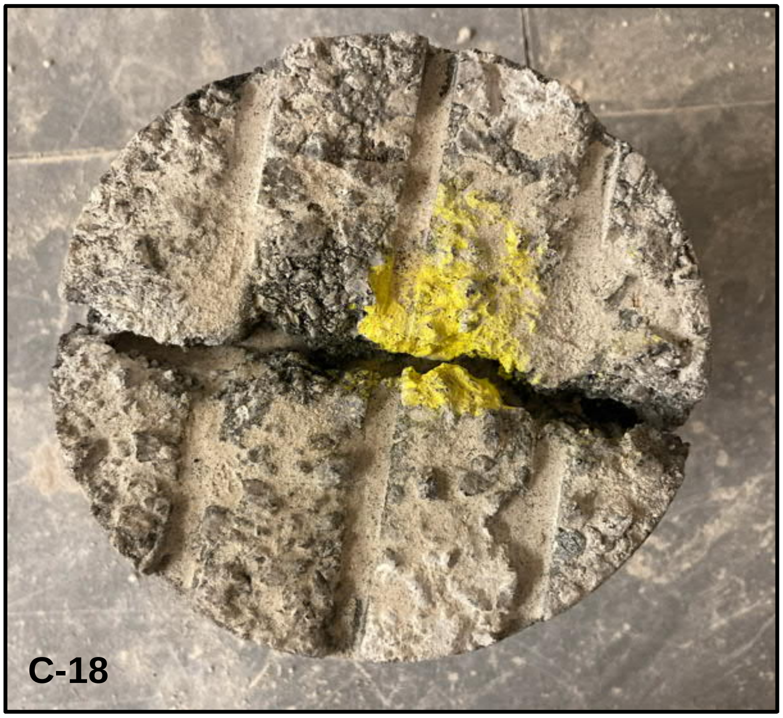
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-13	11.25	11.25

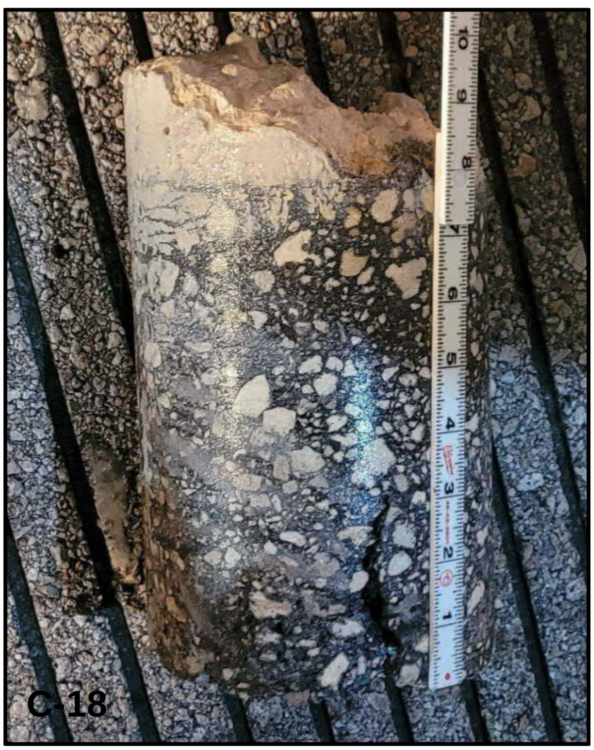
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-14	9.25	9.25	0.5

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-15	6.0	6.0	1.875

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-16	5.5	5.5	1.125

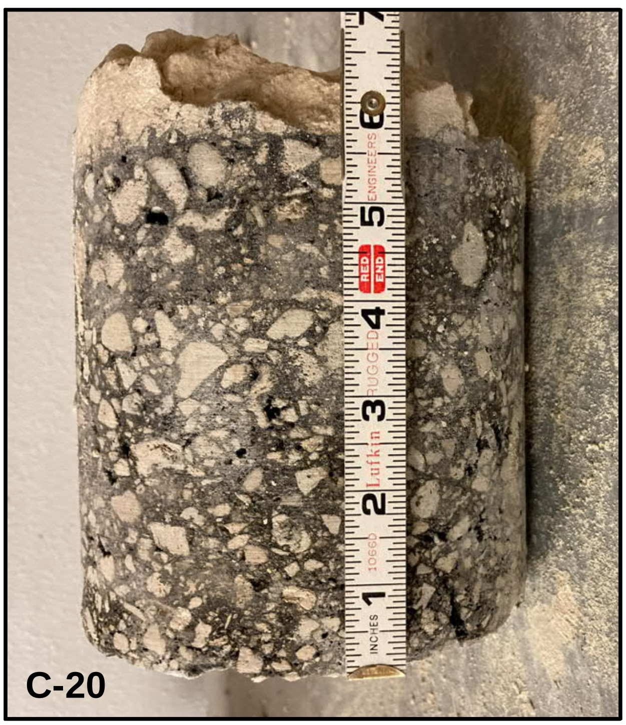
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-17	6.0	6.0	3.25





PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-18	7.875	7.875	3.0

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-19	5.75	5.75	2.5



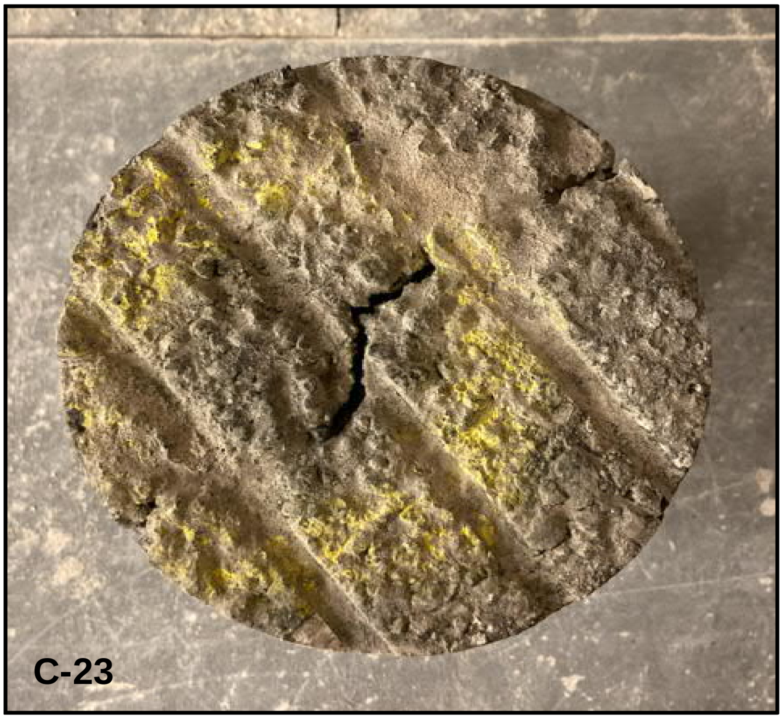
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-20	5.75	5.75	0.75

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-21	9.0	9.0	0.5

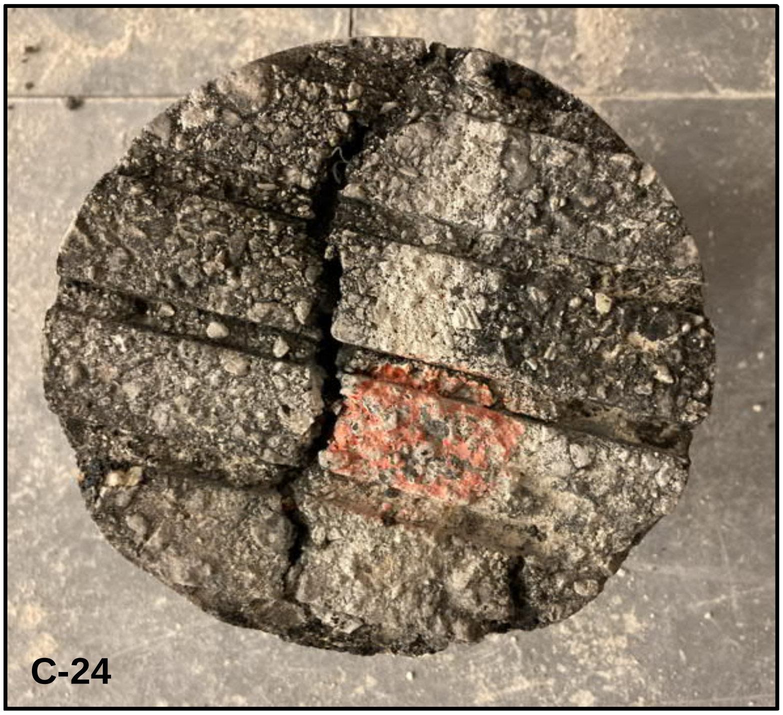
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-22	9.5	9.5

*Crack observed at the surface only.

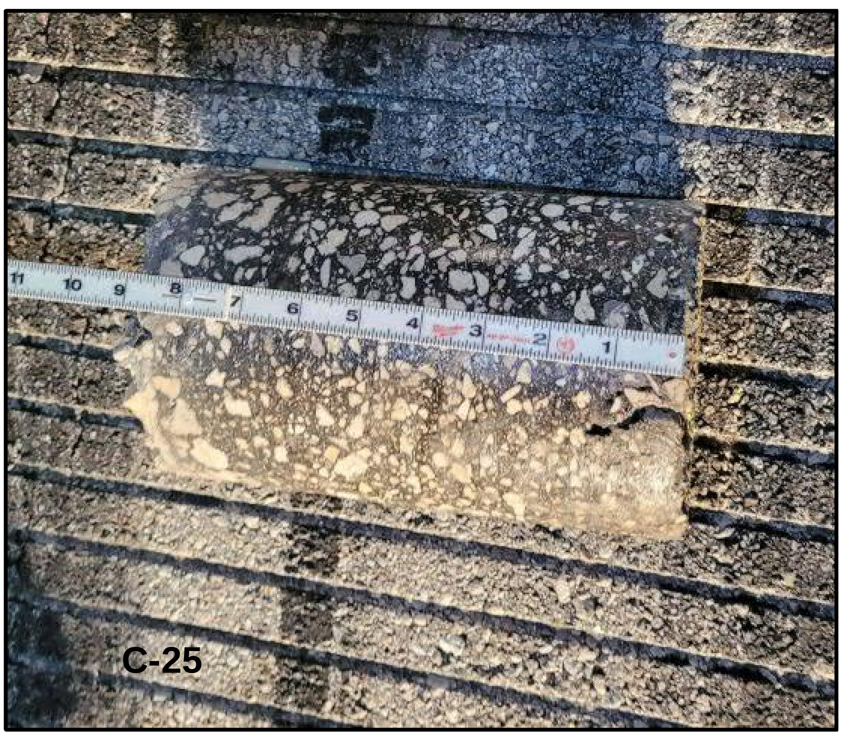
** Fracture shown near the top of core was a result of the core extraction and not debonding of the asphalt itself.



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-23	8.625	8.625	2.125



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-24	6.75	6.75	1.25



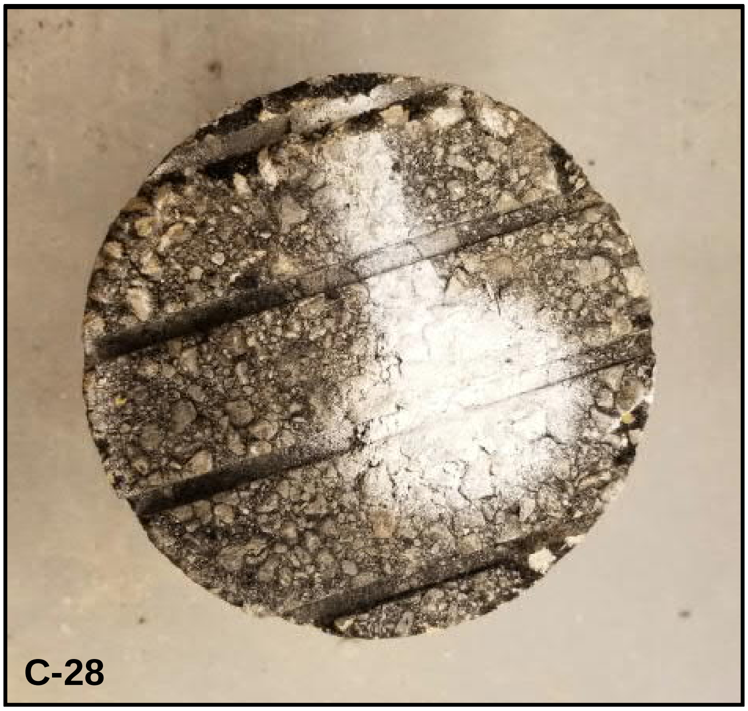
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-25	9.125	9.125	1.5

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-26	9.125	9.125	0.75

C-27

C-27

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-27	7.5	7.5	1.875



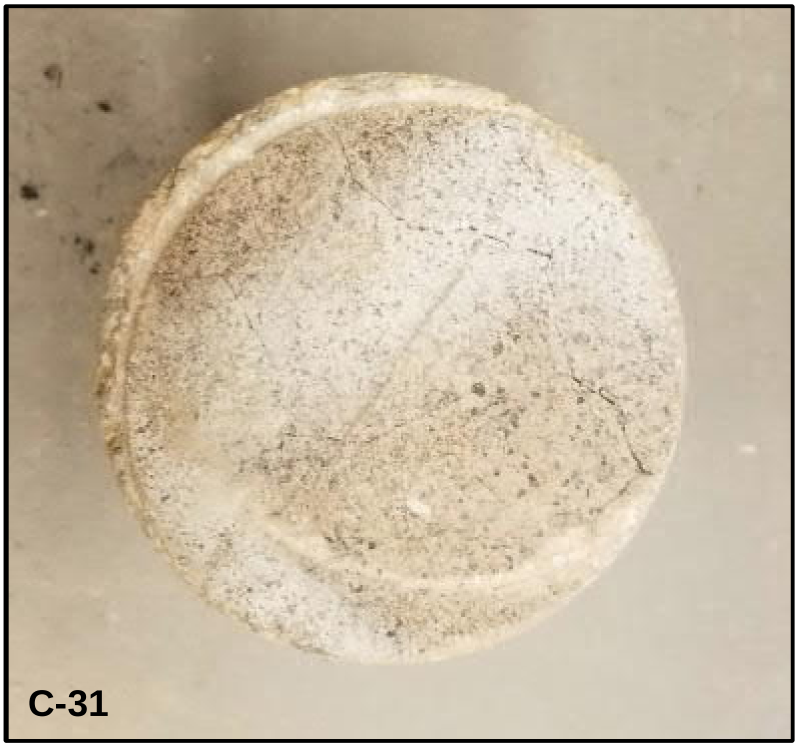
PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
C-28	3.75	8.5	12.25	3.75 to 12.25	5.875 and 7.5	0.25


C-29


C-29

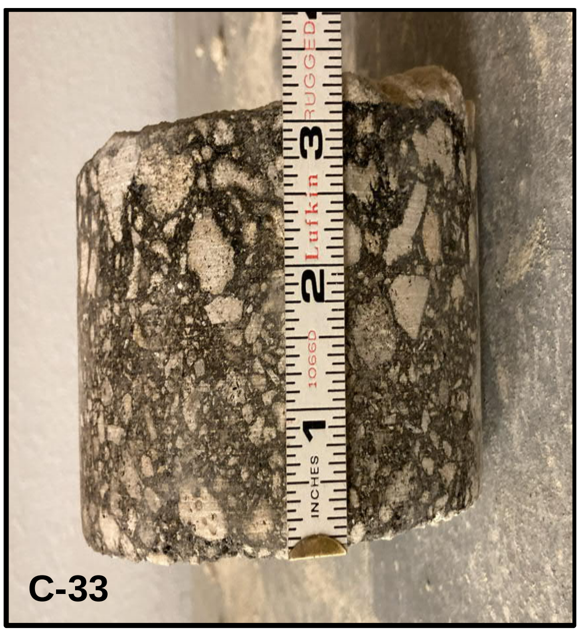
PAVEMENT CORE	ASPHALT THICKNESS (in)	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
C-29	4.5	9.75	14.25	4.5 to 14.25	5.75 and 7.125	0.25

PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
C-30	10.25	10.25	3.875	0.25

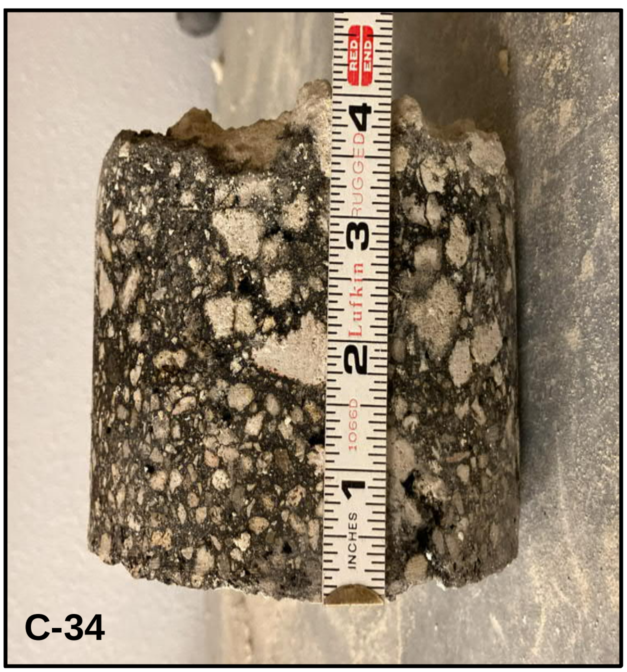


PAVEMENT CORE	CONCRETE THICKNESS (in)	TOTAL THICKNESS (in)	BOTTOM REBAR (in)	REBAR DIAMETER (in)
C-31	10.0	10.0	4.25	0.25

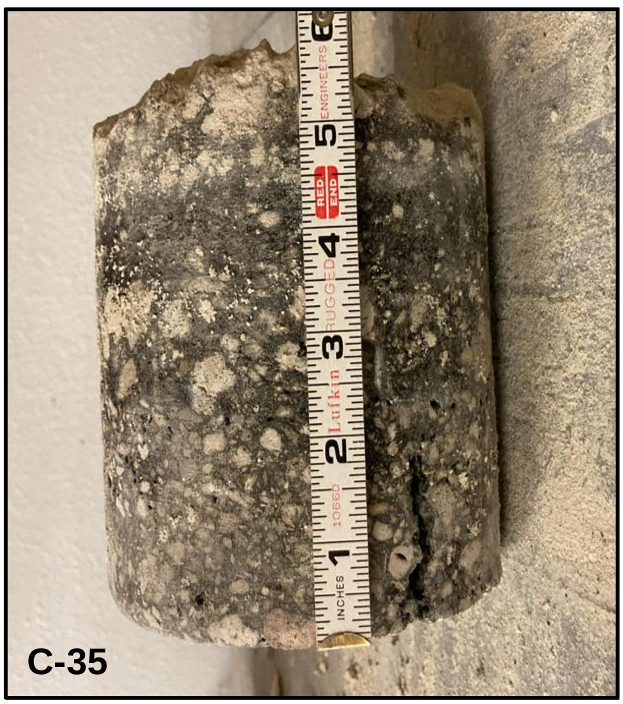
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-32	4.25	4.25



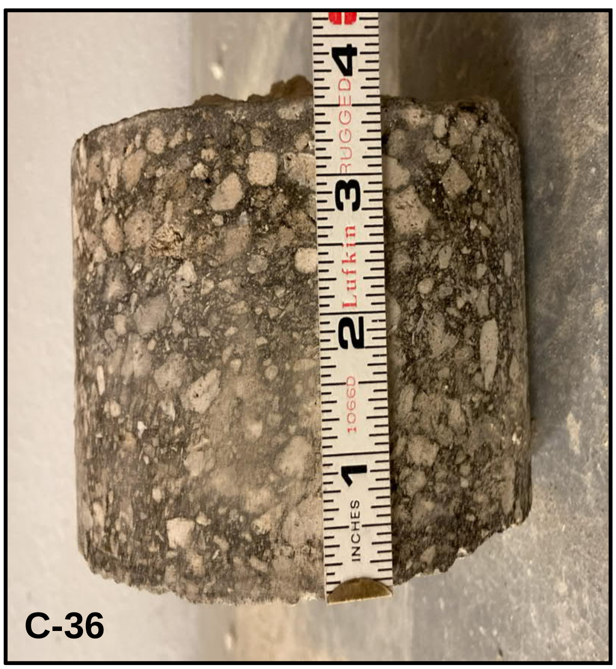
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-33	3.0	3.0



PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-34	3.75	3.75	1.0

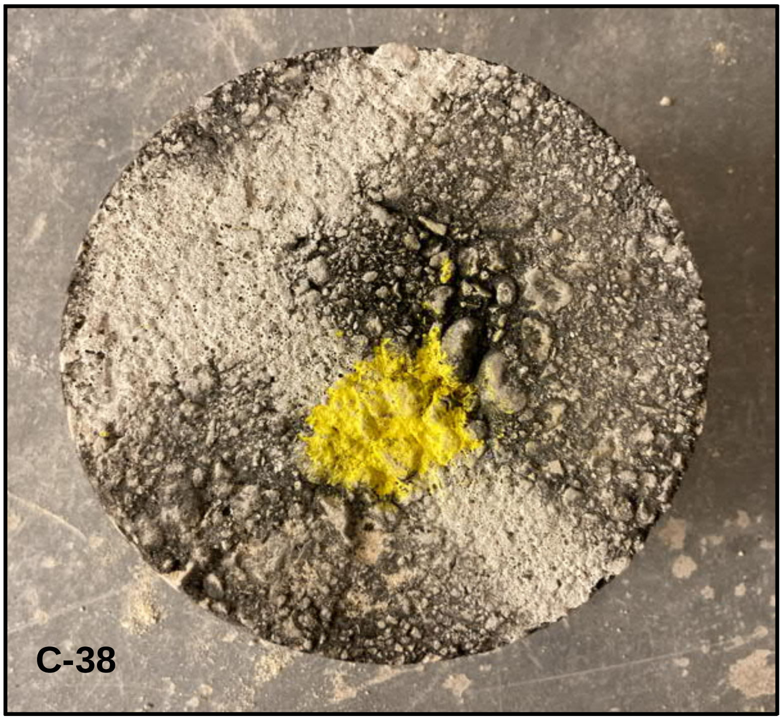


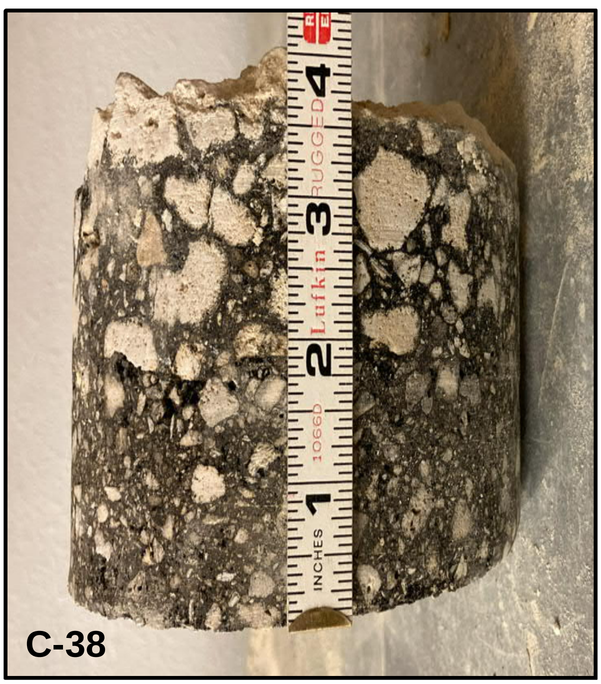
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-35	5.375	5.375	1.875



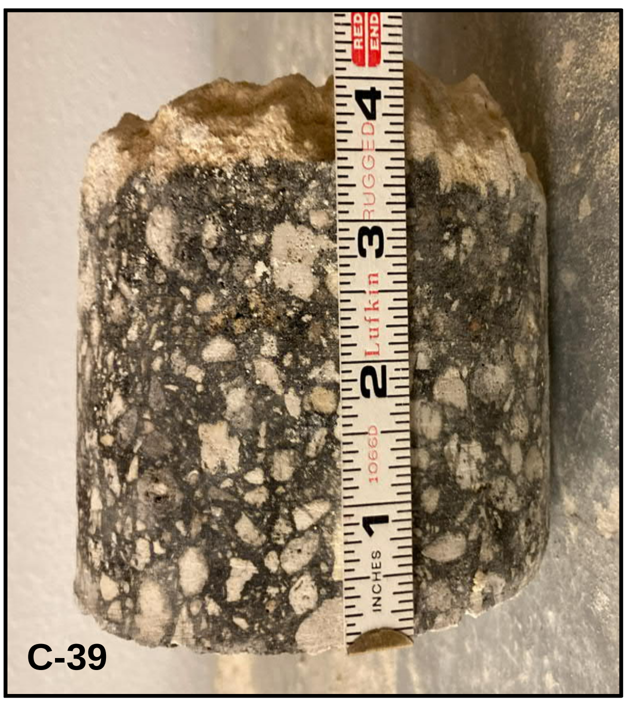
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-36	3.625	3.625

PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)	CRACK DEPTH (in)
C-37	4.75	4,75	0.75





PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-38	3.625	3.625



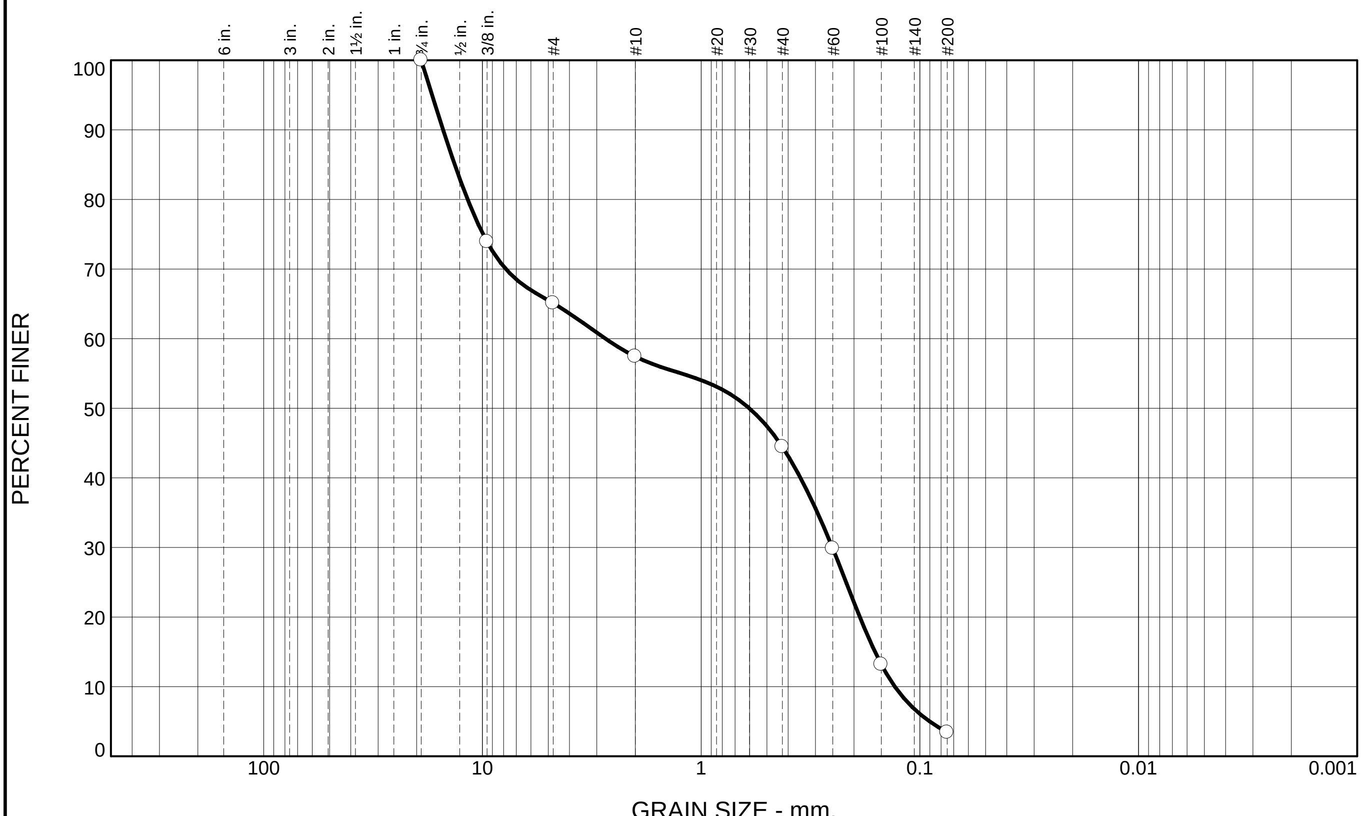
PAVEMENT CORE	ASPHALT THICKNESS (in)	TOTAL THICKNESS (in)
C-39	4.0	4.0

LABORATORY TEST RESULTS

Particle Size Distribution Reports
CBR Test Results
Indirect Tensile Strength Result

PARTICLE SIZE DISTRIBUTION REPORTS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	34.9	7.7	13.0	41.0	3.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	73.9		
#4	65.1		
#10	57.4		
#40	44.4		
#60	29.8		
#100	13.2		
#200	3.4		

* (no specification provided)

Material Description

LIMEROCK, and fine sand, light brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 15.1315 D_{85}= 13.3797 D_{60}= 2.7353
D_{50}= 0.6017 D_{30}= 0.2511 D_{15}= 0.1603
D_{10}= 0.1300 C_u= 21.03 C_c= 0.18

Classification

USCS= SP AASHTO= A-1-b

Remarks

Sample Number: B-1 **Depth:** 0.2-0.9

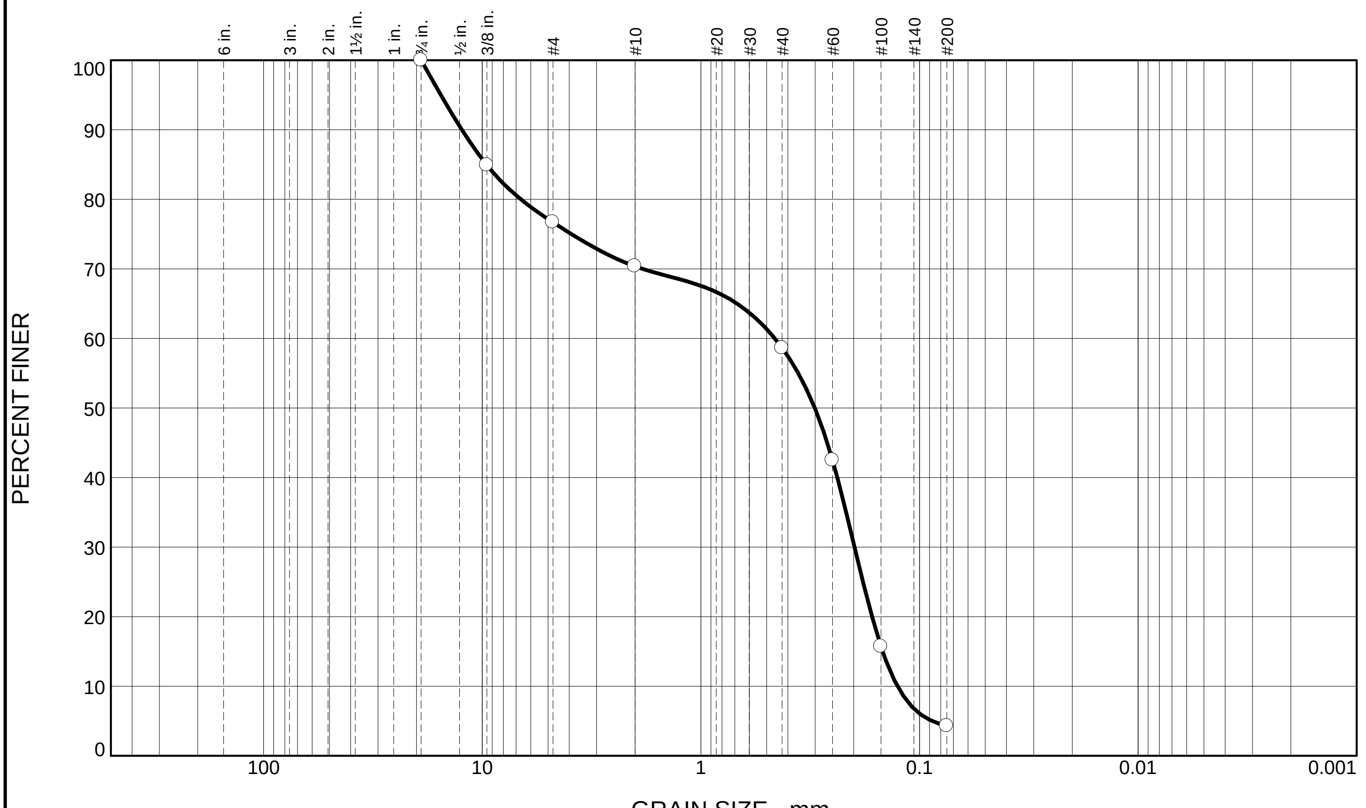
Date: 11/23/2021

Terracon Consultants, Inc.
Maimi Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R

Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	23.3	6.3	11.8	54.3	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	84.9		
#4	76.7		
#10	70.4		
#40	58.6		
#60	42.5		
#100	15.7		
#200	4.3		

* (no specification provided)

Material Description

FINE SAND, with limerock, brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 12.3911 D_{85}= 9.5710 D_{60}= 0.4591
D_{50}= 0.3011 D_{30}= 0.1981 D_{15}= 0.1474
D_{10}= 0.1260 C_u= 3.64 C_c= 0.68

Classification

USCS= SP AASHTO= A-3

Remarks

Sample Number: B-3 **Depth:** 1.6-3.6

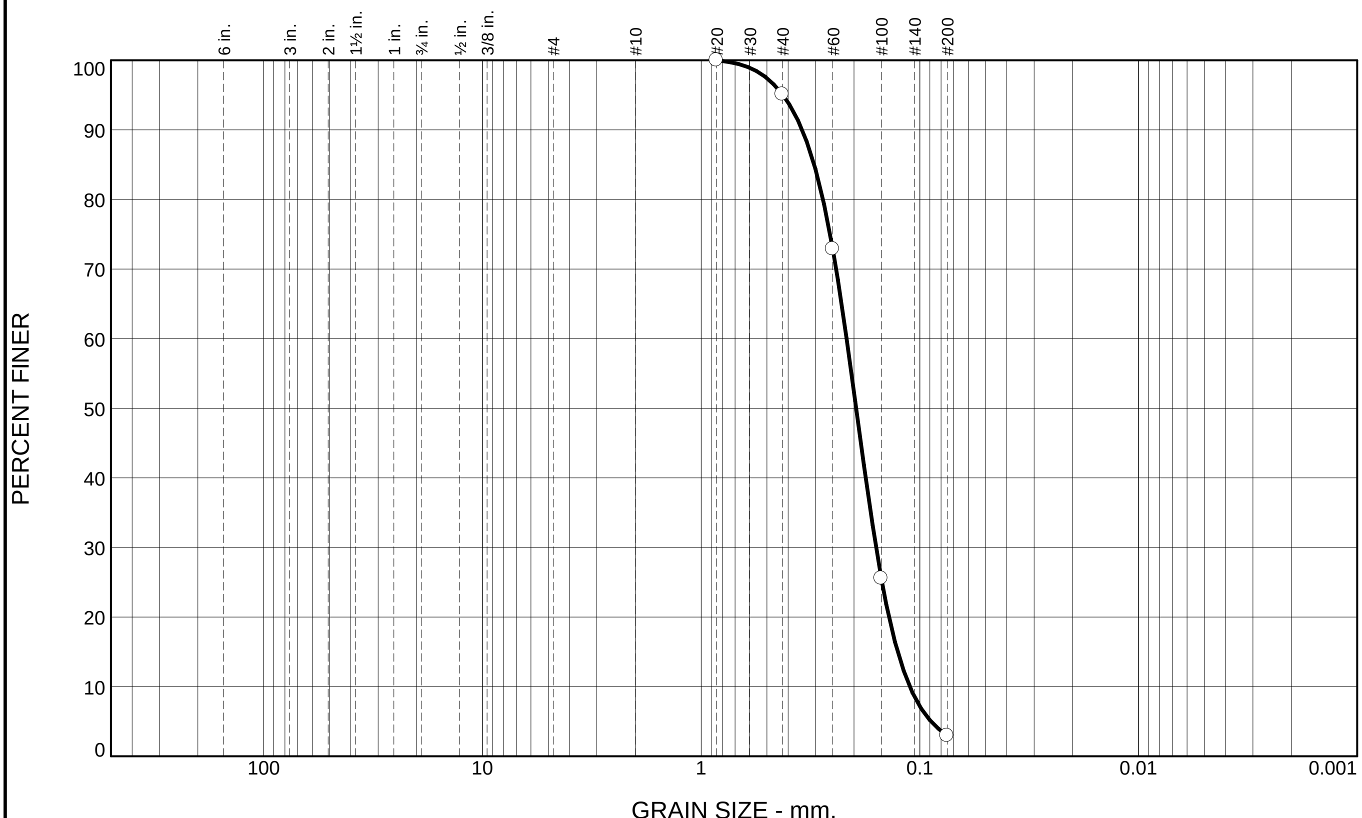
Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R

Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	4.9	92.2	2.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#20	100.0		
#40	95.1		
#60	72.9		
#100	25.6		
#200	2.9		

* (no specification provided)

Material Description

FINE SAND, light gray and brown

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 0.3450 D_{85}= 0.3042 D_{60}= 0.2162
D_{50}= 0.1954 D_{30}= 0.1585 D_{15}= 0.1262
D_{10}= 0.1112 C_u= 1.94 C_c= 1.05

Classification

USCS= SP AASHTO= A-3

Remarks

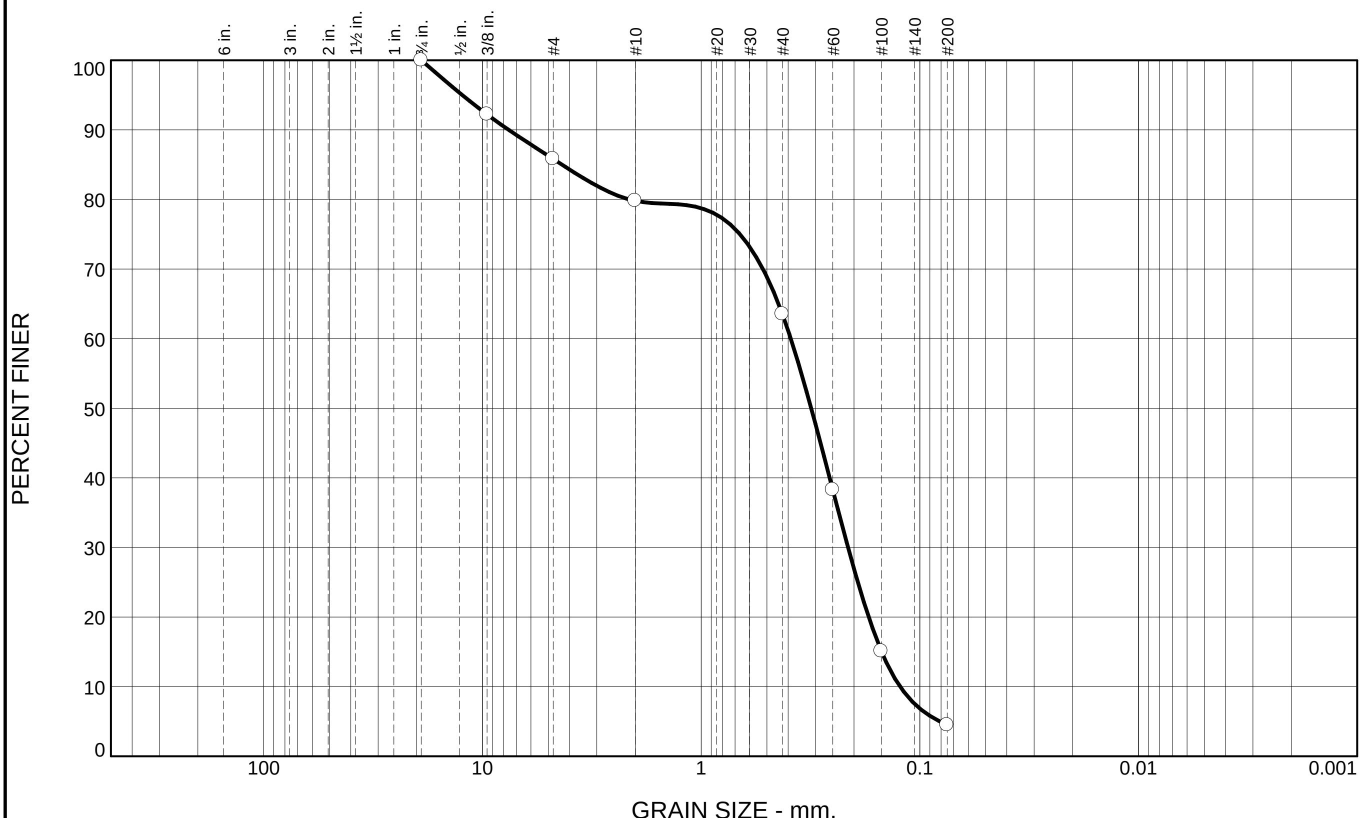
Sample Number: B-4 **Depth:** 2.3-4.3

Date: 11/23/2021

Terracon Consultants, Inc
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.2	6.0	16.3	59.0	4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	92.2		
#4	85.8		
#10	79.8		
#40	63.5		
#60	38.3		
#100	15.1		
#200	4.5		

* (no specification provided)

Material Description

FINE SAND, with limerock, brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 7.5817 D_{85}= 4.3272 D_{60}= 0.3890
D_{50}= 0.3138 D_{30}= 0.2128 D_{15}= 0.1495
D_{10}= 0.1230 C_u= 3.16 C_c= 0.95

Classification

USCS= SP AASHTO= A-3

Remarks

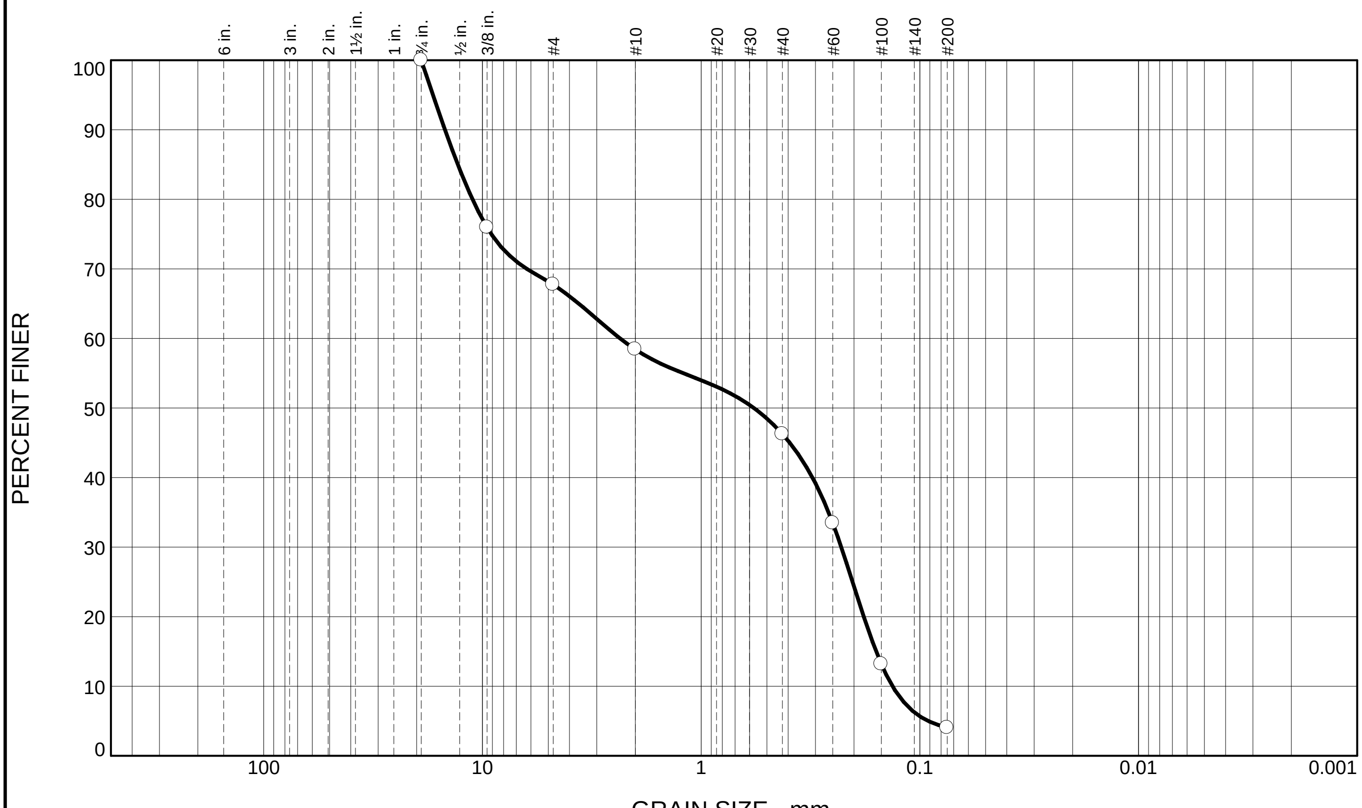
Sample Number: B-15 **Depth:** 1.3-2.0

Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	32.2	9.4	12.1	42.3	4.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	76.0		
#4	67.8		
#10	58.4		
#40	46.3		
#60	33.4		
#100	13.2		
#200	4.0		

* (no specification provided)

Material Description

FINE SAND, with limerock, light brown and brown

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 14.8346 D_{85}= 12.9533 D_{60}= 2.3445
D_{50}= 0.5734 D_{30}= 0.2286 D_{15}= 0.1584
D_{10}= 0.1332 C_u= 17.60 C_c= 0.17

Classification

USCS= SP AASHTO= A-1-b

Remarks

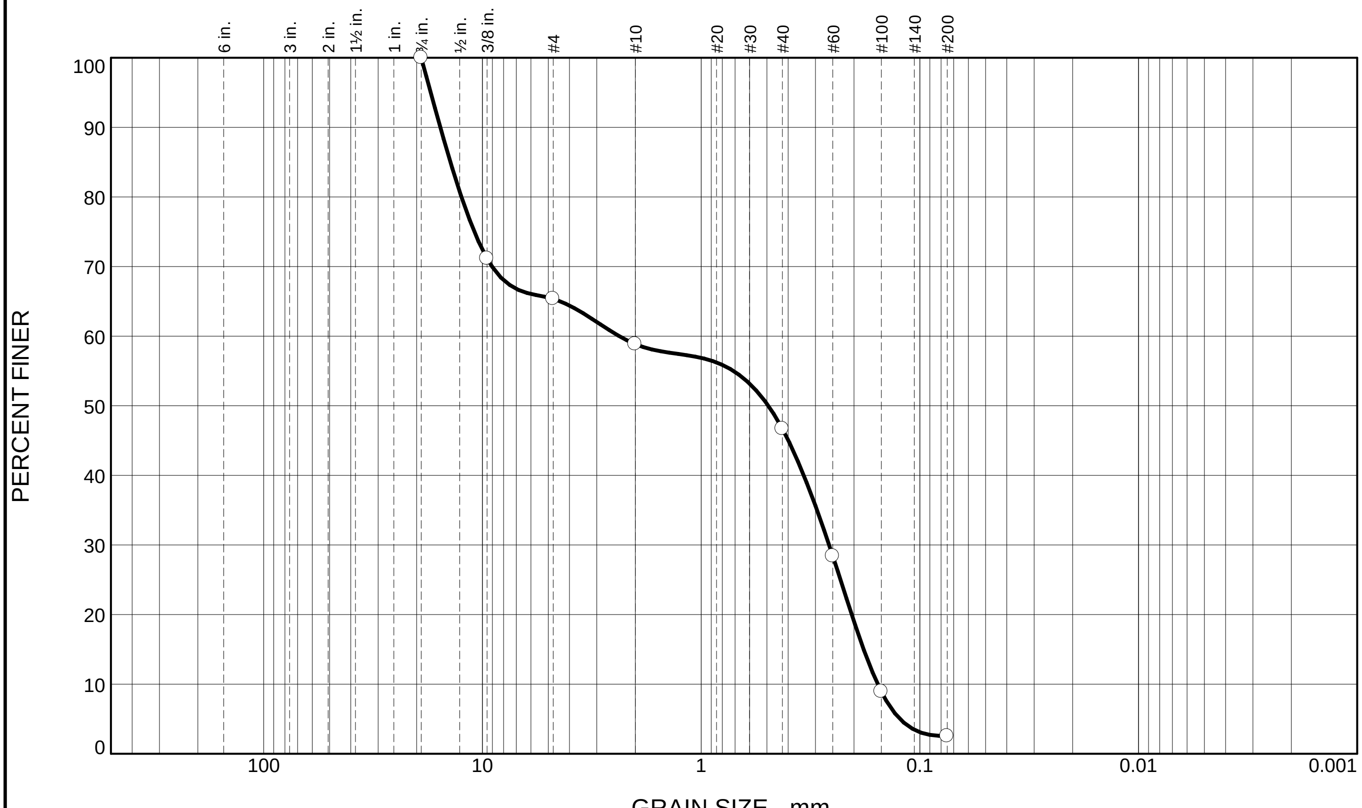
Sample Number: B-17 **Depth:** 0.9-1.5

Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	34.6	6.5	12.2	44.2	2.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	71.2		
#4	65.4		
#10	58.9		
#40	46.7		
#60	28.4		
#100	8.9		
#200	2.5		

* (no specification provided)

Material Description

FINE SAND, with limerock, brown

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 15.5818 D_{85}= 14.0049 D_{60}= 2.3647
D_{50}= 0.4928 D_{30}= 0.2599 D_{15}= 0.1805
D_{10}= 0.1558 C_u= 15.18 C_c= 0.18

Classification

USCS= SP AASHTO= A-1-b

Remarks

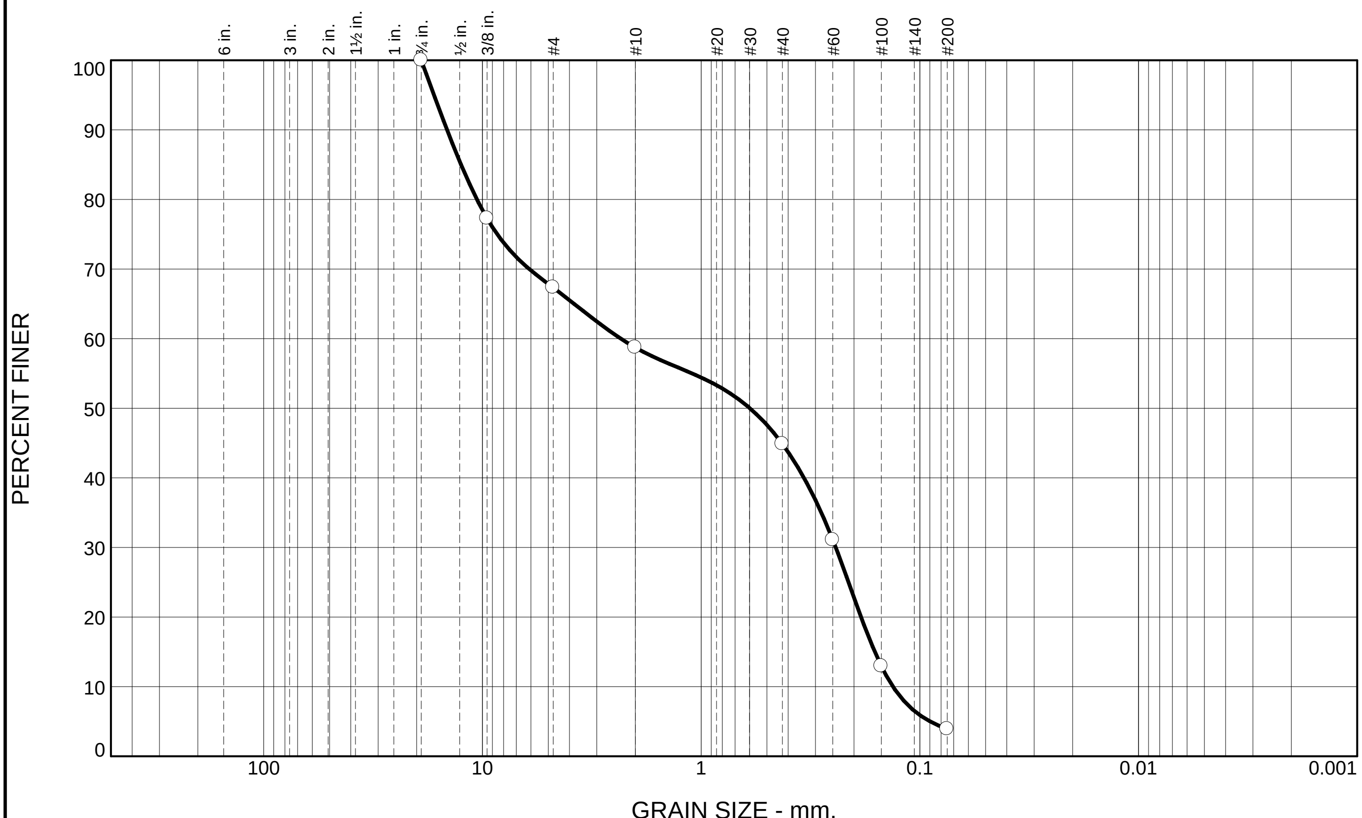
Sample Number: B-18 **Depth:** 0.8-1.4

Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	32.7	8.6	13.8	41.0	3.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	77.3		
#4	67.3		
#10	58.7		
#40	44.9		
#60	31.1		
#100	13.0		
#200	3.9		

* (no specification provided)

Material Description

FINE SAND, trace to with limerock, brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 14.5128 D_{85}= 12.5234 D_{60}= 2.3275
D_{50}= 0.5981 D_{30}= 0.2423 D_{15}= 0.1606
D_{10}= 0.1326 C_u= 17.55 C_c= 0.19

Classification

USCS= SP AASHTO= A-1-b

Remarks

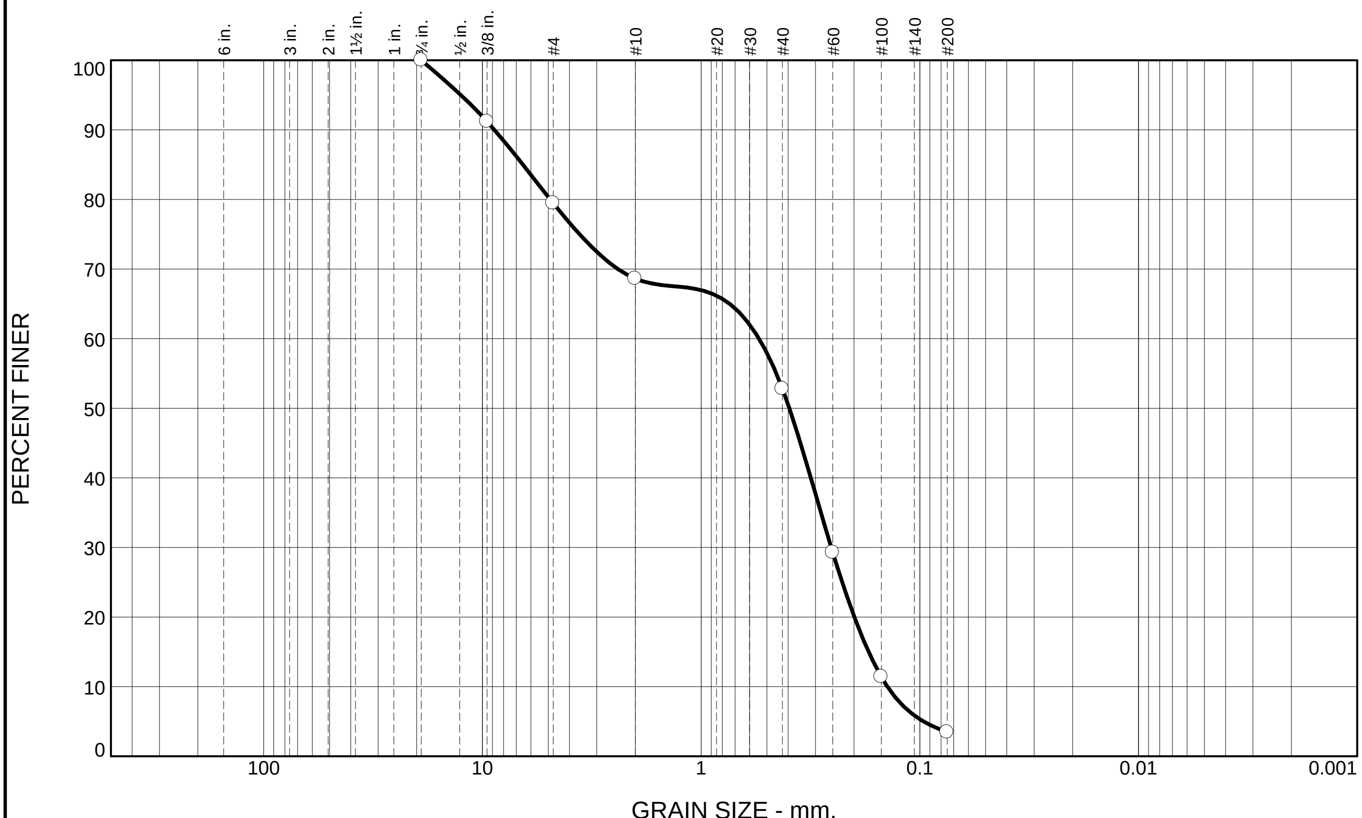
Sample Number: B-19 **Depth:** 0.9-1.4

Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	20.5	10.9	15.8	49.3	3.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	91.2		
#4	79.5		
#10	68.6		
#40	52.8		
#60	29.3		
#100	11.4		
#200	3.5		

* (no specification provided)

Material Description

FINE SAND, with limerock, brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 8.8176 D_{85}= 6.5336 D_{60}= 0.5435
D_{50}= 0.3949 D_{30}= 0.2541 D_{15}= 0.1714
D_{10}= 0.1406 C_u= 3.87 C_c= 0.85

Classification

USCS= SP AASHTO= A-3

Remarks

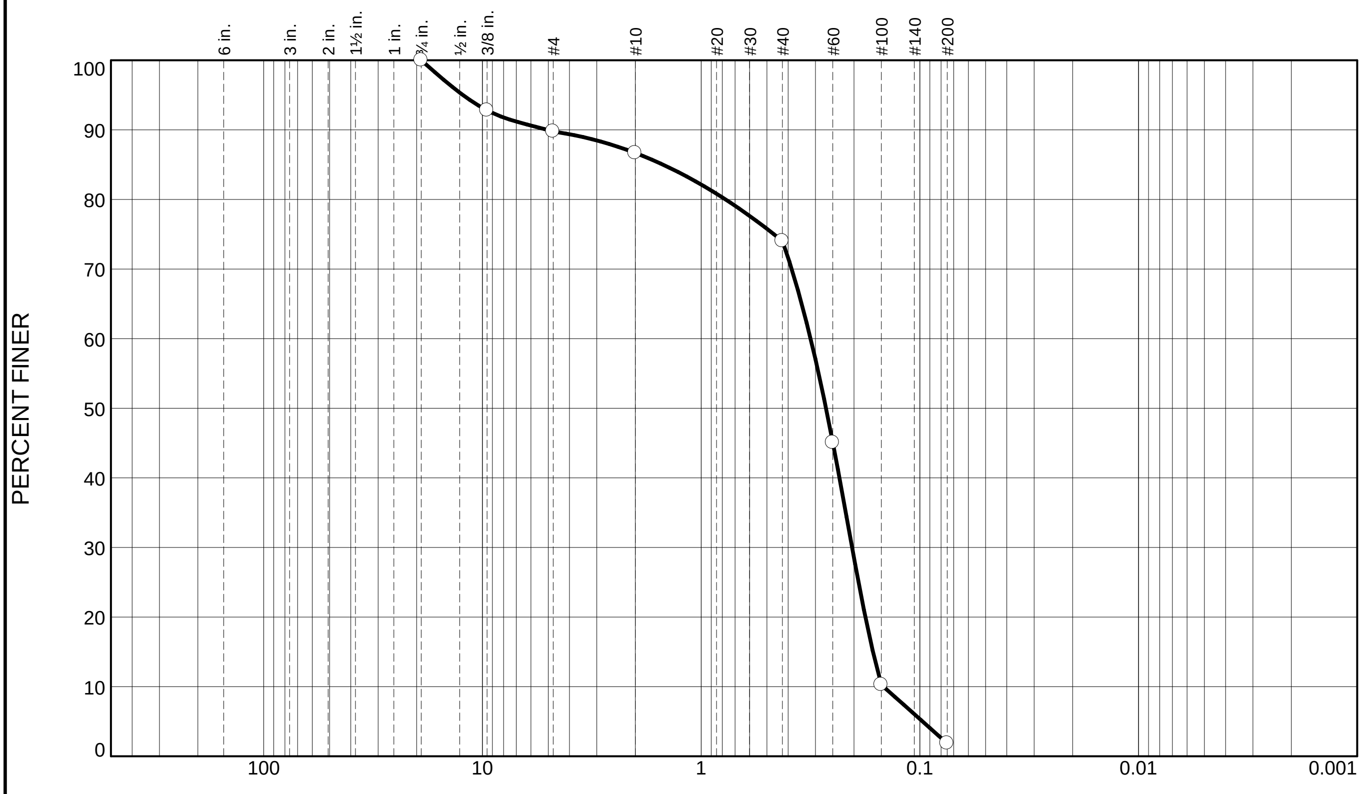
Sample Number: B-20 **Depth:** 0.8-1.5

Date: 11/22/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.2	3.1	12.7	72.1	1.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	92.8		
#4	89.8		
#10	86.7		
#40	74.0		
#60	45.1		
#100	10.3		
#200	1.9		

* (no specification provided)

Material Description

FINE SAND, with limerock, brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 5.0460 D_{85}= 1.4943 D_{60}= 0.3159
D_{50}= 0.2686 D_{30}= 0.2040 D_{15}= 0.1638
D_{10}= 0.1465 C_u= 2.16 C_c= 0.90

Classification

USCS= SP AASHTO= A-3

Remarks

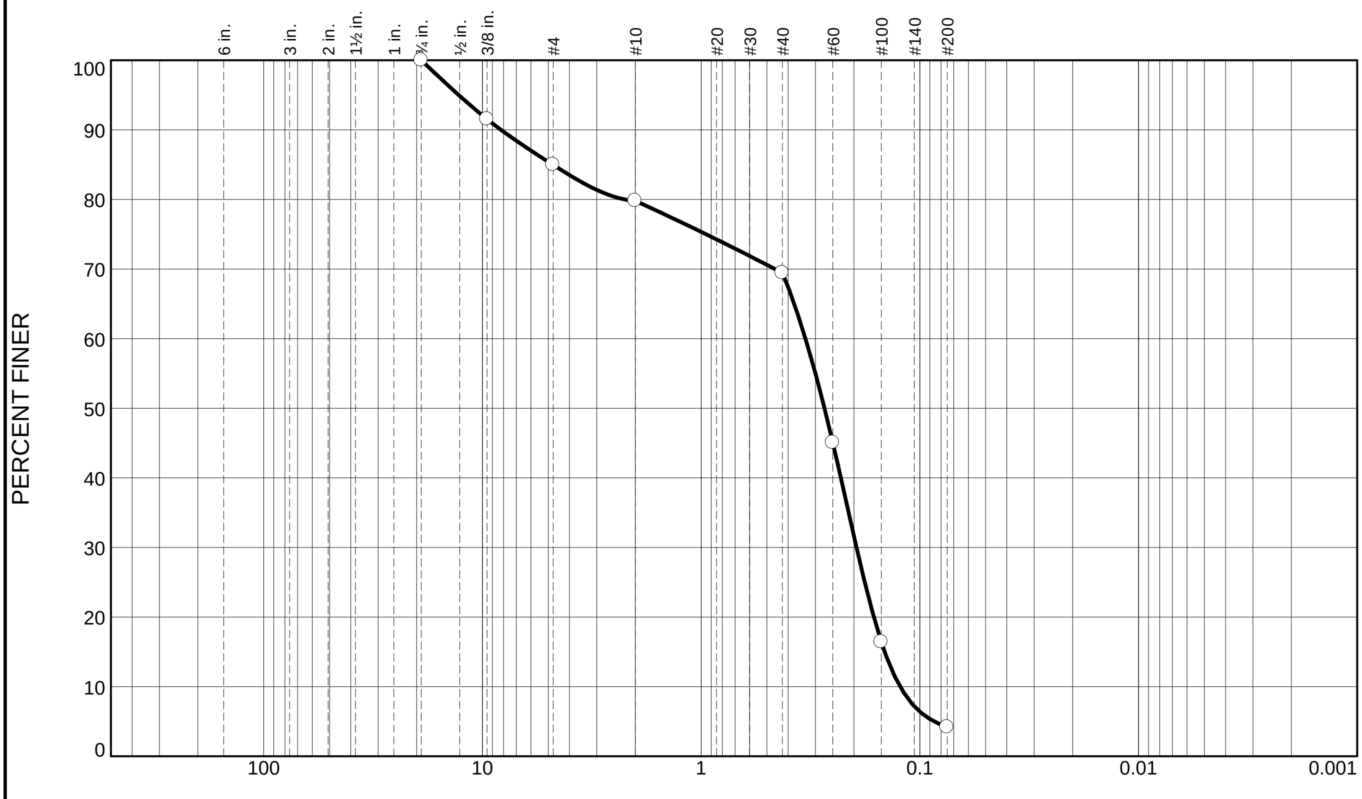
Sample Number: B-21 **Depth:** 1-1.8

Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.0	5.2	10.4	65.2	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	91.5		
#4	85.0		
#10	79.8		
#40	69.4		
#60	45.1		
#100	16.4		
#200	4.2		

* (no specification provided)

Material Description

FINE SAND, with limerock, brownish gray

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 8.2198 D_{85}= 4.7651 D_{60}= 0.3333
D_{50}= 0.2729 D_{30}= 0.1947 D_{15}= 0.1447
D_{10}= 0.1230 C_u= 2.71 C_c= 0.92

Classification

USCS= SP AASHTO= A-3

Remarks

Sample Number: B-25 **Depth:** 0.8-1.5

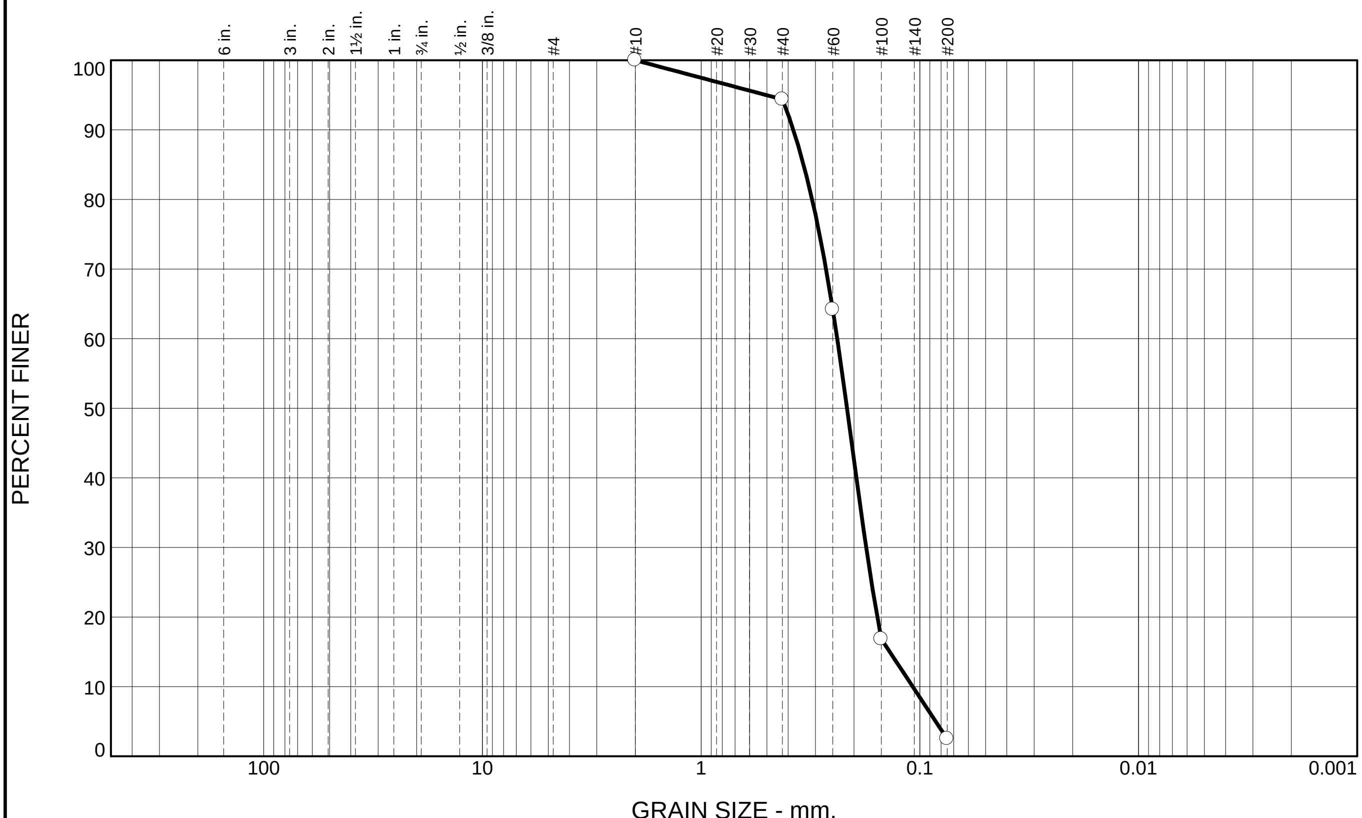
Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, Inc.

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R

Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	5.6	91.9	2.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	94.4		
#60	64.2		
#100	16.8		
#200	2.5		

* (no specification provided)

Material Description

FINE SAND, light gray to brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.3786 D_{85}= 0.3399 D_{60}= 0.2386
D_{50}= 0.2152 D_{30}= 0.1759 D_{15}= 0.1372
D_{10}= 0.1077 C_u= 2.22 C_c= 1.20

Classification

USCS= SP AASHTO= A-3

Remarks

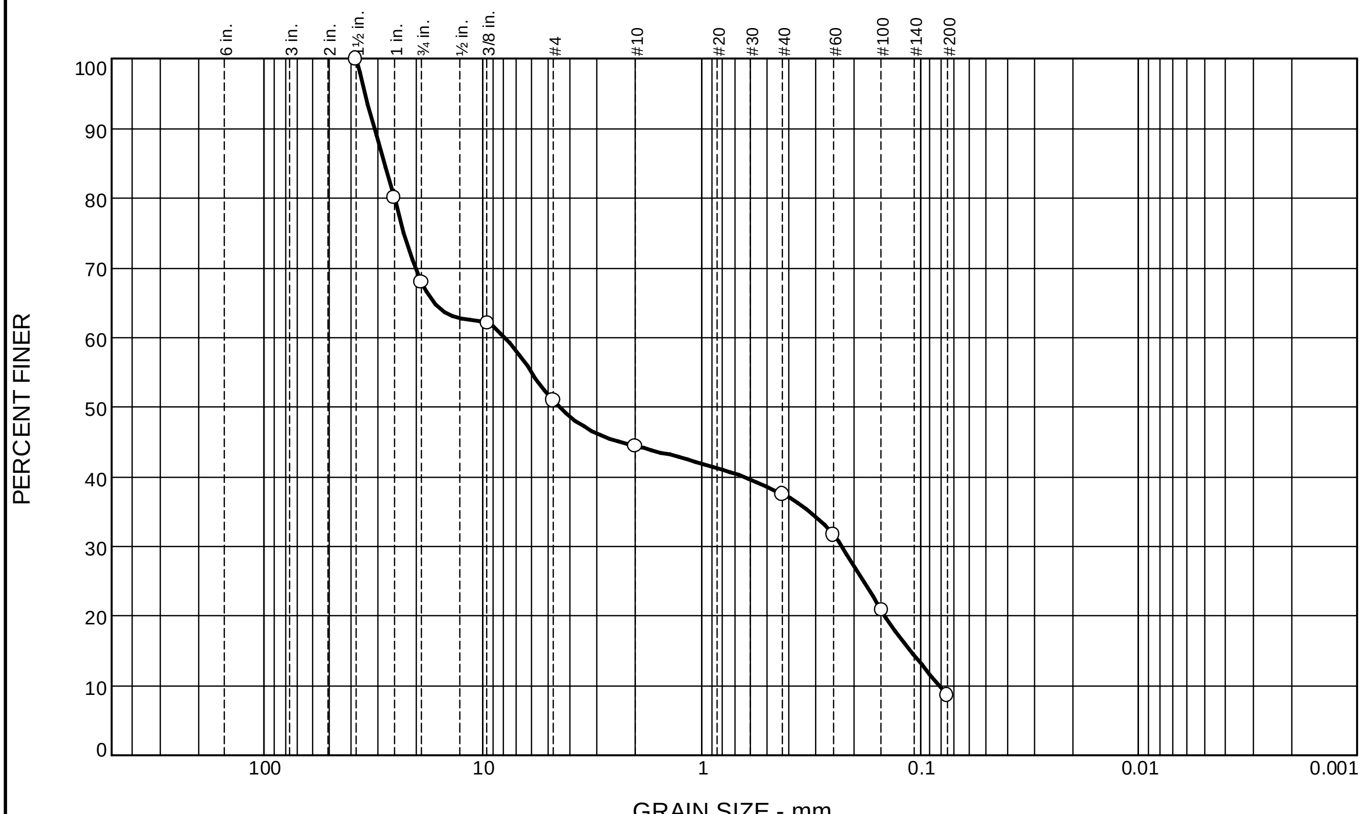
Sample Number: B-26 **Depth:** 0.8-1.5

Date: 11/23/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	32.0	17.0	6.6	6.9	28.9	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	80.1		
.75	68.0		
.375	62.0		
#4	51.0		
#10	44.4		
#40	37.5		
#60	31.7		
#100	20.8		
#200	8.6		

* (no specification provided)

Material Description

Limerock with Fine Sand, Slightly Silty Fine Sand, light brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 31.1268 D_{85}= 28.1131 D_{60}= 7.9306
D_{50}= 4.4476 D_{30}= 0.2284 D_{15}= 0.1107
D_{10}= 0.0818 C_u= 96.90 C_c= 0.08

Classification

USCS= GP-GM AASHTO= A-1-b

Remarks

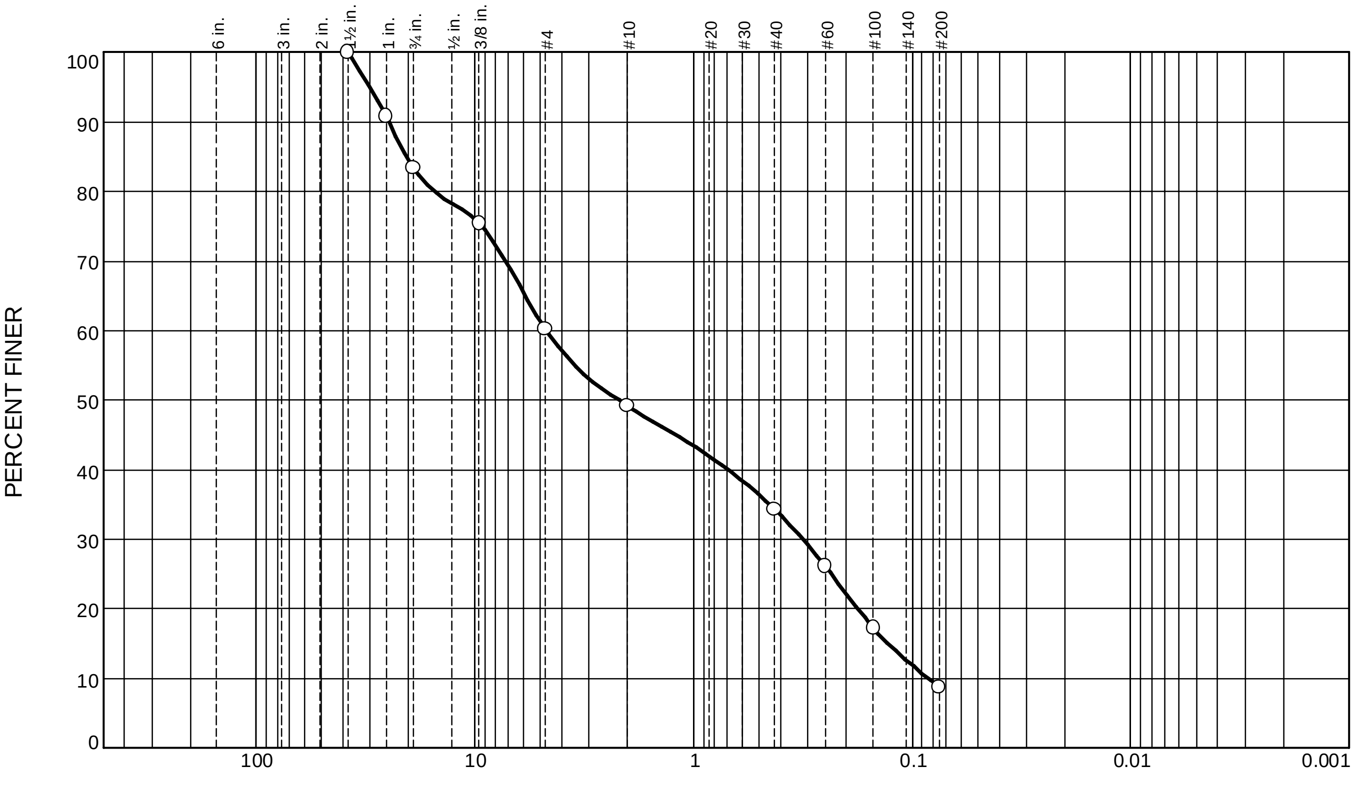
Sample Number: Bulk S at B-6 **Depth:** Base

Date: 12/2/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.6	23.1	11.1	14.8	25.6	8.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	90.8		
.75	83.4		
.375	75.4		
#4	60.3		
#10	49.2		
#40	34.4		
#60	26.1		
#100	17.2		
#200	8.8		

* (no specification provided)

Material Description

Limerock with Fine Sand, Slightly Silty Fine Sand, light brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 24.6393 D_{85}= 20.4332 D_{60}= 4.6874
D_{50}= 2.1989 D_{30}= 0.3153 D_{15}= 0.1286
D_{10}= 0.0842 C_u= 55.65 C_c= 0.25

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

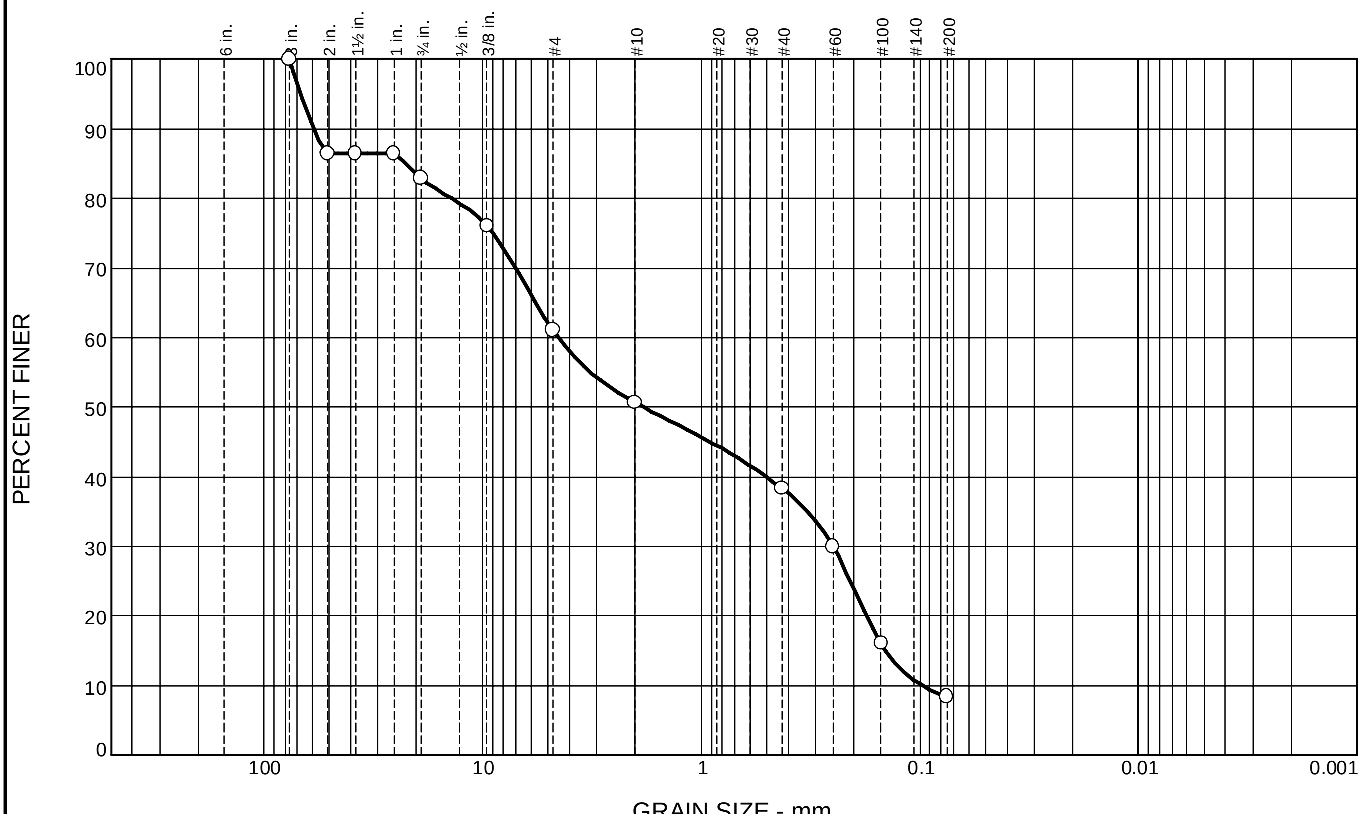
Sample Number: Bulk S at B-9/B-8 **Depth:** Base

Date: 12/2/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	17.1	21.8	10.4	12.4	29.9	8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	86.4		
1.5	86.4		
1	86.4		
.75	82.9		
.375	76.0		
#4	61.1		
#10	50.7		
#40	38.3		
#60	30.0		
#100	16.1		
#200	8.4		

* (no specification provided)

Material Description

Limerock with Fine Sand, Slightly Silty Fine Sand, light brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 59.1976 D_{85}= 22.3276 D_{60}= 4.4876
D_{50}= 1.8206 D_{30}= 0.2503 D_{15}= 0.1425
D_{10}= 0.0970 C_u= 46.26 C_c= 0.14

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sample Number: Bulk S at B-22 **Depth:** Base

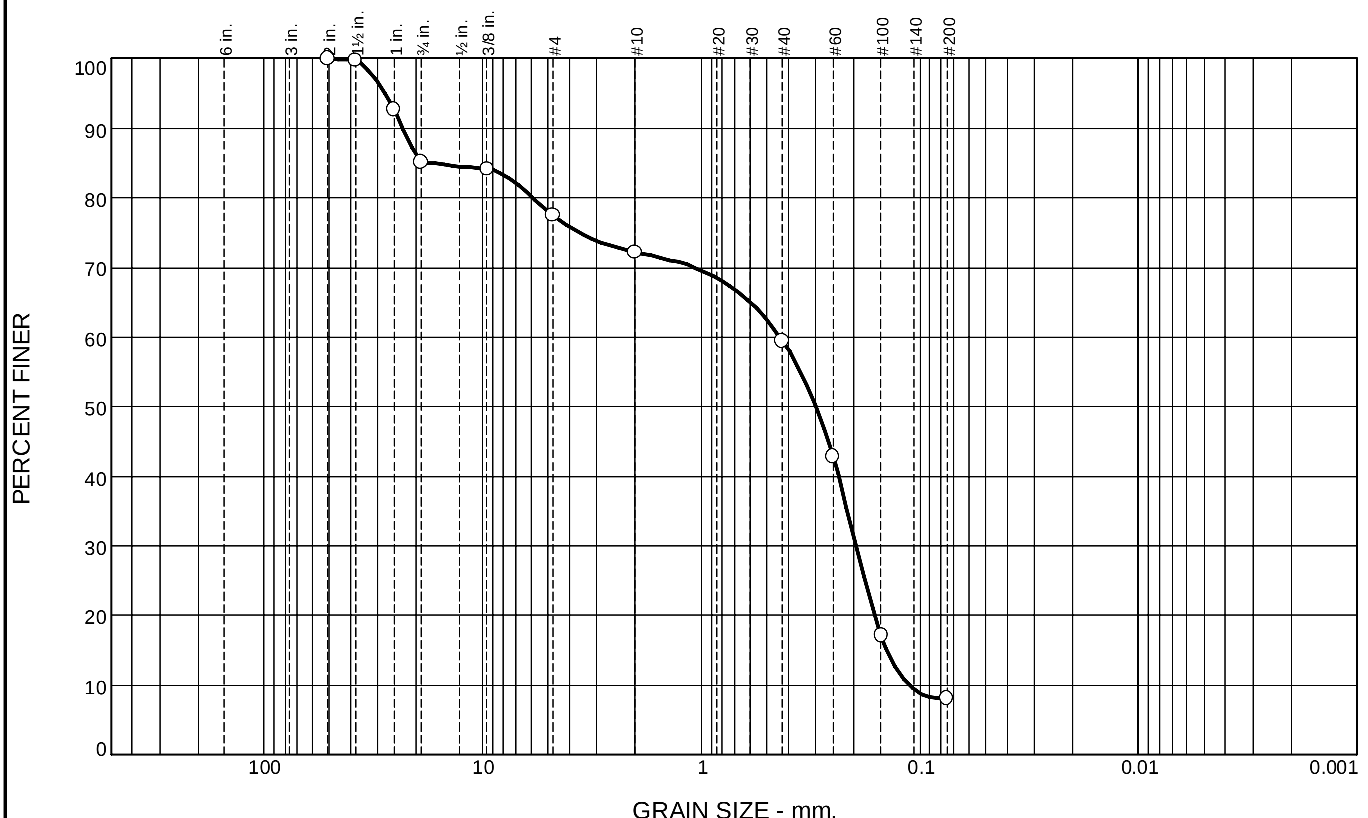
Date: 12/2/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R

Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.9	7.6	5.3	12.8	51.3	8.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	99.8		
1	92.7		
.75	85.1		
.375	84.1		
#4	77.5		
#10	72.2		
#40	59.4		
#60	42.8		
#100	17.1		
#200	8.1		

* (no specification provided)

Material Description

Fine Sand and Limerock Fragments, light brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 23.0988 D_{85}= 17.5384 D_{60}= 0.4373
D_{50}= 0.2982 D_{30}= 0.1956 D_{15}= 0.1411
D_{10}= 0.1122 C_u= 3.90 C_c= 0.78

Classification

USCS= SP-SM AASHTO= A-3

Remarks

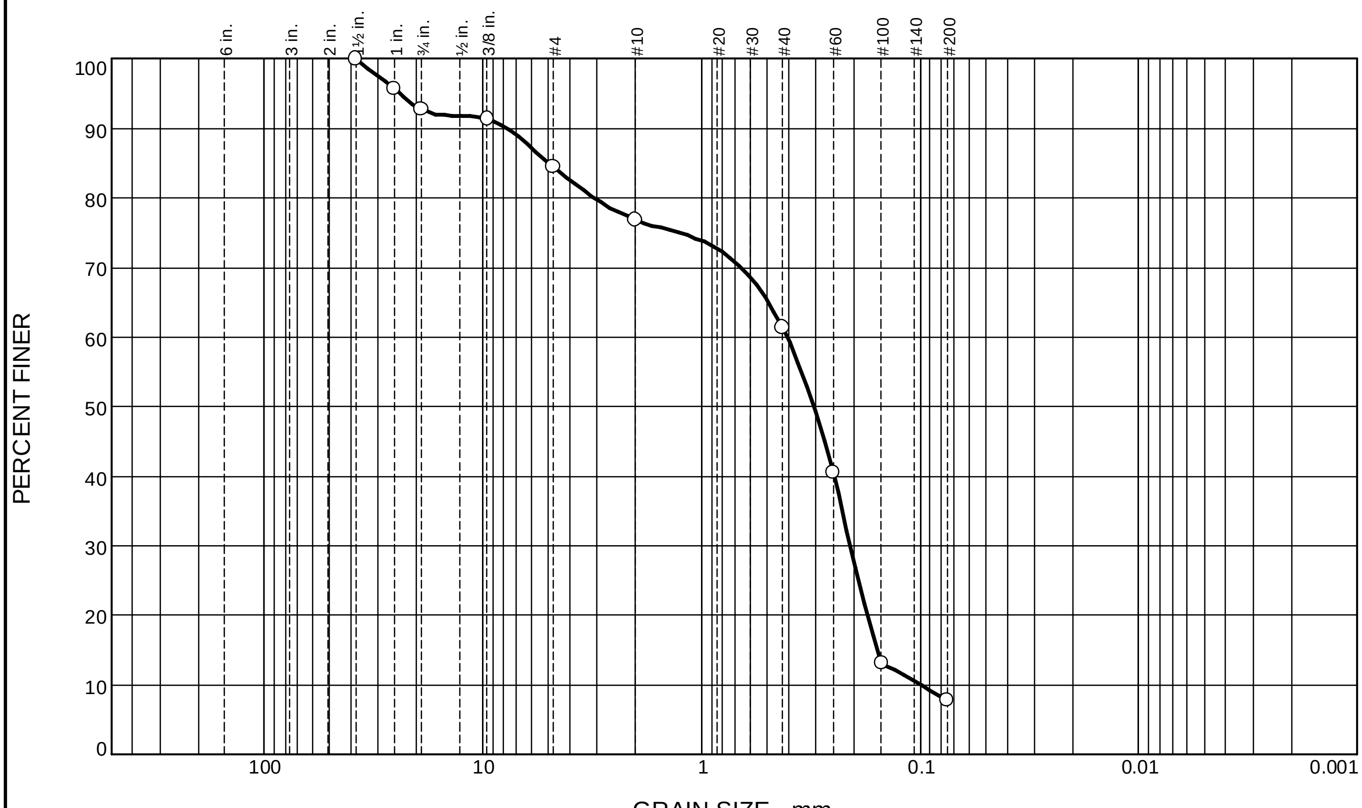
Sample Number: Bulk S at B-8 **Depth:** Sub Grade

Date: 12/2/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.2	8.3	7.6	15.5	53.5	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	95.7		
.75	92.8		
.375	91.4		
#4	84.5		
#10	76.9		
#40	61.4		
#60	40.5		
#100	13.2		
#200	7.9		

* (no specification provided)

Material Description

Fine Sand and Limerock Fragments, light brown

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 7.7420 D_{85}= 4.9512 D_{60}= 0.4044
D_{50}= 0.3049 D_{30}= 0.2082 D_{15}= 0.1569
D_{10}= 0.0990 C_u= 4.09 C_c= 1.08

Classification

USCS= SP-SM AASHTO= A-3

Remarks

Sample Number: Bulk S at B-9 **Depth:** Sub Grade

Date: 12/2/2021

Terracon Consultants, Inc.
Miami Lakes, FL

Client: Atkins Global
Project: Rehabilitation of OPF Runway 97-27R
Project No: H8205120 **Figure**

CBR TEST RESULTS

CTI

Construction Testing & Inspection, Inc.

AASHTO T-180 METHOD "D"
COMPACTION TEST MODIFIED PROCTOR WORKSHEET
MOLD VOLUME 1/13.33 CF

FM 1-T180
Form #09-10-2021

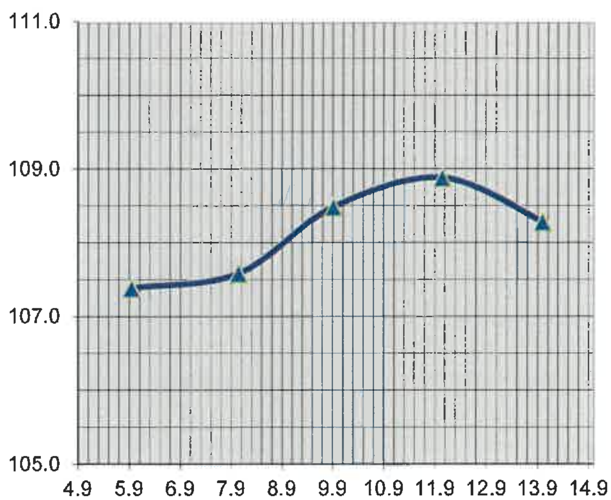
PROJECT NO. RUNWAY 9L-27R REH TESTED BY: L12642158-000 PEN. BY L12642158-000
CLIENT TERRACON/11684 LOCATION OPA-LOCKA AIRPORT
MATERIAL NO. 200/CBR DATE COMPACTED 10/22/2021
SAMPLE NO. # 4 B-1 B-2 MATERIAL DESCRIPTION Light Grey Fine Sand
SAMPLED BY Sampled by Client LAB NO S210381

MOISTURE CONTENT	5.9	8.0	9.9	12.0	14.0	
PAN NO.	**1**	**2**	**3**	**4**	**5**	
PAN & WET SOIL	**924**	**935.1**	**940.1**	**937.6**	**946.8**	
PAN & DRY SOIL	**894.1**	**894.6**	**890.6**	**878.9**	**878.5**	
WT OF WATER	29.9	40.5	49.5	58.7	68.3	
WT OF PAN	**390.9**	**390.9**	**391**	**391.6**	**389.9**	
WT OF DRY SOIL	503.2	503.7	499.6	487.3	488.6	

MOLD NO	**437**	**437**	**437**	**437**	**437**	
WET WT. + MOLD	**14.706**	**14.890**	**15.114**	**15.324**	**15.441**	
WT OF MOLD	**6.177**	**6.177**	**6.177**	**6.177**	**6.177**	
WET WT.	8.529	8.713	8.937	9.147	9.264	
WET UNIT WT	113.7	116.2	119.2	122.0	123.5	
DRY UNIT WT.	107.4	107.6	108.5	108.9	108.3	

Maximum Density	Optimum Moisture
108.9	**12.0**

Moisture-Density Relationship



Moisture Content (%)

Plastic Index	Remarks	Soil Classification M-145- T88
NP		**N/A**

Organic Results FM1-T267		Gradation (T-27)	
Crucible #1	**N/A**	Range	Results
Crucible #2	**N/A**	(3-1/2") 100	**N/A**
Crucible #3	**N/A**	(3/4") 70 - 100	**N/A**
Average	**N/A**	(4) 30 - 100	**N/A**
		(40) 15 - 100	**N/A**
(T-11) % Passing 200 sieve		(100) 5 - 65	**N/A**
N/A		(200) 0 -15	**N/A**

Respectfully Submitted,
Construction Testing & Inspection, Inc.

PAUL C. MARTIN LICENSE No 65051 STATE OF FLORIDA PROFESSIONAL ENGINEER

Paul C Martin
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic devises.
2021.10.26 15:58:41 -04'00'

Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

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CTI Construction Testing & Inspection, Inc.

California Bearing Ratio Test
Data Sheet

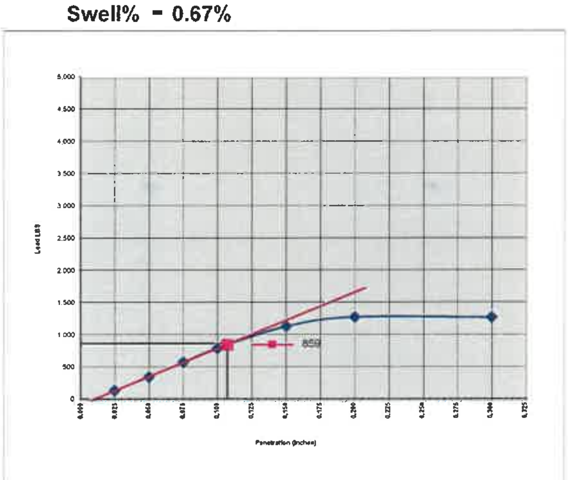
Form #09-10-:

Client:	TERRACON/11684	**Tested By:**	L12642158-000
Project No:	RUNWAY 9L-27R REH	**Date Compacted:**	10/22/21
Sample Description:	Light Grey Fine Sand	**Date Penetrated:**	10/26/21
Sampled By	Sampled by Client	**Sample No.**	# 4 B-1 B-2
		Lab No.	S210381

Count	X Penetration In.	y Load LBS.	Slope Y\X
2	0.025	158	6320
4	0.050	369	8440
5	0.075	593	8960
6	0.100	811	8720
7	0.150	1,148	6740
8	0.200	1,292	2880
9	0.300	1,288	-40

Max Slope:	8960
Avg Slope:	8700
Y Intercept:	-61.6667
X Offset:	0.007088
Pent. Corr:	0.107088
Corr. Load:	870
Slope CBR:	29
Data Slope:	6740
Data Y Inter:	137
Data Load:	859
Data CBR:	36
Corrected CBR:	29.0

Swell% - 0.67%



Molding Moisture Content: 12.0%
Molding Dry Density: 108.9 pcf
Estimated Post-Soak Moisture Content: 19.6%

Respectfully Submitted,
Construction Testing & Inspection, Inc.

Paul C Martin
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic devises.
2021.10.27 15:35:21 -04'00'

Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

CTI

Construction Testing & Inspection, Inc.

AASHTO T-180 METHOD "D"
COMPACTION TEST MODIFIED PROCTOR WORKSHEET
MOLD VOLUME 1/13.33 CF

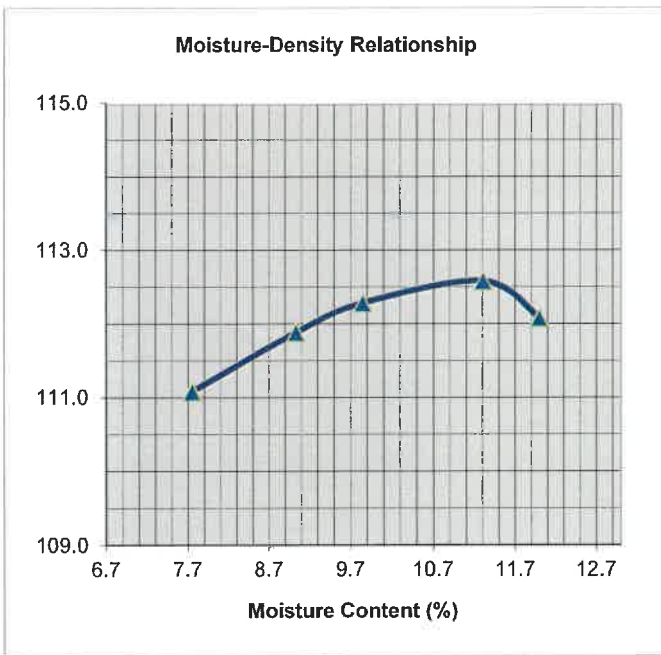
FM 1-T180
Form #09-10-2021

PROJECT NO. RUNWAY 9L-27R REH TESTED BY: L12642158-000 PEN. BY L12642158-000
CLIENT TERRACON/11684 LOCATION OPA LOCKA AIRPORT
MATERIAL NO. 200/CBR DATE COMPACTED 10/22/2021
SAMPLE NO. 3 B-6 B-22 B-22 MATERIAL DESCRIPTION Grey Fine Sand with rocks
SAMPLED BY Sampled by Client LAB NO S210380

MOISTURE CONTENT	7.7	9.0	9.8	11.3	12.0	
PAN NO.	**6**	**7**	**8**	**9**	**10**	
PAN & WET SOIL	**950.6**	**952.4**	**956.4**	**961.2**	**966.3**	
PAN & DRY SOIL	**909.8**	**905.4**	**905.3**	**902.8**	**904.6**	
WT OF WATER	40.8	47.0	51.1	58.4	61.7	
WT OF PAN	**383.3**	**385.1**	**386.4**	**386.3**	**392.3**	
WT OF DRY SOIL	526.5	520.3	518.9	516.5	512.3	

MOLD NO	**437**	**437**	**437**	**437**	**437**	
WET WT. + MOLD	**15.152**	**15.330**	**15.423**	**15.571**	**15.588**	
WT OF MOLD	**6.177**	**6.177**	**6.177**	**6.177**	**6.177**	
WET WT.	8.975	9.153	9.246	9.394	9.411	
WET UNIT WT	119.7	122.0	123.3	125.3	125.5	
DRY UNIT WT.	111.1	111.9	112.3	112.6	112.1	

Maximum Density	Optimum Moisture
112.6	**11.3**



Plastic Index	Remarks	Soil Classification M-145- T88
NP		**N/A**

Organic Results FM1-T267		Gradation (T-27)	
Crucible #1	**N/A**	Range	Results
Crucible #2	**N/A**	(3-1/2") 100	**N/A**
Crucible #3	**N/A**	(3/4") 70 - 100	**N/A**
Average	**N/A**	(4) 30 - 100	**N/A**
		(40) 15 - 100	**N/A**
(T-11) % Passing 200 sieve		(100) 5 - 65	**N/A**
N/A		(200) 0 -15	**N/A**

Respectfully Submitted,
Construction Testing & Inspection, Inc.

Paul C Martin
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2021.10.26 15:56:45 -04'00'

Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

CTI Construction Testing & Inspection, Inc.

California Bearing Ratio Test
Data Sheet

Form #09-10-:

Client:	TERRACON/11684
Project No:	RUNWAY 9L-27R REH
Sample Description:	Grey Fine Sand with rocks
Sampled By	Sampled by Client

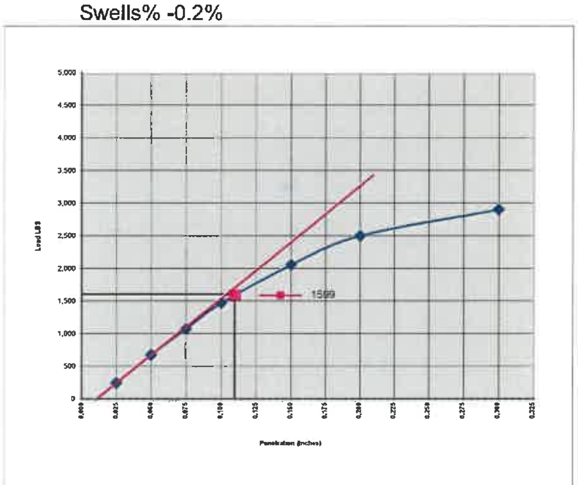
Tested By:	L12642158-000
Date Compacted:	10/22/21
Date Penetrated:	10/26/21
Sample No.	#3 B-6 B-22 B-22
Lab No.	S210380

Count	X Penetration In.	y Load LBS.	Slope Y\X
2	0.025	267	10680
4	0.050	698	17240
5	0.075	1,091	15720
6	0.100	1,488	15880
7	0.150	2,071	11660
8	0.200	2,516	8900
9	0.300	2,918	4020

Max Slope:	17240
Avg Slope:	17240
Y Intercept:	-164
X Offset:	0.009513
Pent. Corr:	0.109513
Corr. Load:	1724
Slope CBR:	57
Data Slope:	11660
Data Y Inter:	322
Data Load:	1599
Data CBR:	67
Corrected CBR:	57.5

Molding Moisture Content: 11.3%
Molding Dry Density: 112.6 pcf
Estimated Post-Soak Moisture Content: 17.7%

Swells% -0.2%



Respectfully Submitted,
Construction Testing & Inspection, Inc.

Paul C Martin
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Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

Corporate Office: 509 Sawgrass Corporate Parkway, Sunrise, Florida 33325 • 954.835.6000 • Fax: 954.835.6060
Personnel Certified/Qualified By: CTQP FDOT CMEC ACI NICET • Laboratory Accreditation By: AASHTO/CMEC
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Construction Testing & Inspection, Inc.

AASHTO T-180 METHOD "D"
COMPACTION TEST MODIFIED PROCTOR WORKSHEET
MOLD VOLUME 1/13.33 CF

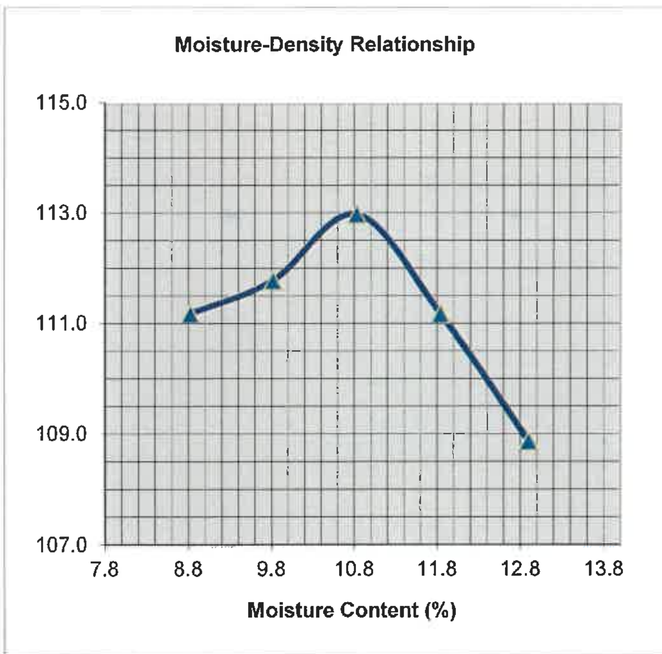
FM 1-T180
Form #09-10-2021

PROJECT NO. RUNWAY 9L-27R REH TESTED BY: L12642158-000 PEN. BY L12642158-000
CLIENT TERRACON/11684 LOCATION OPA-LOCKA AIRPORT
MATERIAL NO. 200/CBR DATE COMPACTED 10/22/2021
SAMPLE NO. B-2 B-3 MATERIAL DESCRIPTION Light Grey Fine Sand
SAMPLED BY Sampled by Client LAB NO S210379

MOISTURE CONTENT	8.8	9.8	10.8	11.8	12.9	
PAN NO.	**1**	**2**	**3**	**4**	**5**	
PAN & WET SOIL	**969.6**	**950.4**	**960**	**970.6**	**963.6**	
PAN & DRY SOIL	**922.7**	**900.4**	**904.4**	**909.3**	**897.9**	
WT OF WATER	46.9	50.0	55.6	61.3	65.7	
WT OF PAN	**391.1**	**391**	**390.9**	**391.6**	**389.9**	
WT OF DRY SOIL	531.6	509.4	513.5	517.7	508.0	

MOLD NO	**437**	**437**	**437**	**437**	**437**	
WET WT. + MOLD	**15.251**	**15.385**	**15.570**	**15.499**	**15.401**	
WT OF MOLD	**6.177**	**6.177**	**6.177**	**6.177**	**6.177**	
WET WT.	9.074	9.208	9.393	9.322	9.224	
WET UNIT WT	121.0	122.8	125.2	124.3	123.0	
DRY UNIT WT.	111.2	111.8	113.0	111.2	108.9	

Maximum Density	Optimum Moisture
113	**10.8**



Plastic Index	Remarks	Soil Classification M-145- T88
NP		**N/A**

Organic Results FM1-T267		Gradation (T-27)	
Crucible #1	**N/A**	Range	Results
Crucible #2	**N/A**	(3-1/2") 100	**N/A**
Crucible #3	**N/A**	(3/4") 70 - 100	**N/A**
Average	**N/A**	(4) 30 - 100	**N/A**
		(40) 15 - 100	**N/A**
(T-11) % Passing 200 sieve		(100) 5 - 65	**N/A**
N/A		(200) 0 -15	**N/A**

Respectfully Submitted,
Construction Testing & Inspection, Inc.

PAUL D. MARTIN LICENSE No. 65051 STATE OF FLORIDA PROFESSIONAL ENGINEER

Paul C Martin
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Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

CTI **Construction Testing & Inspection, Inc.**

California Bearing Ratio Test
Data Sheet

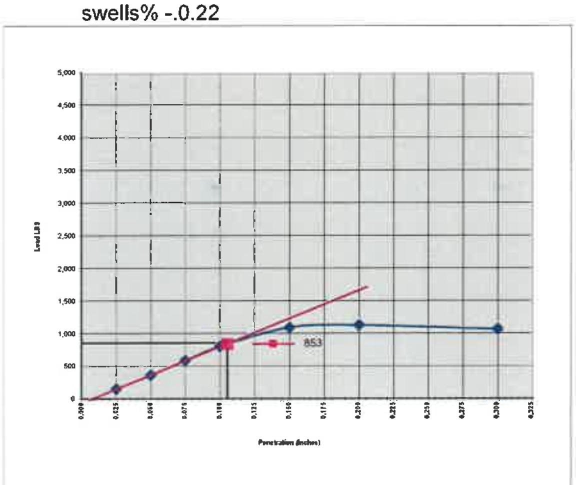
Form #09-10-:

Client:	TERRACON/11684	**Tested By:**	L12642158-000
Project No:	RUNWAY 9L-27R REH	**Date Compacted:**	10/22/21
Sample Description:	Light Grey Fine Sand	**Date Penetrated:**	10/26/21
Sampled By	Sampled by Client	**Sample No.**	B-2 B-3
		Lab No.	S210379

Count	X Penetration In.	y Load LBS.	Slope Y\X
2	0.025	172	6880
4	0.050	382	8400
5	0.075	605	8920
6	0.100	822	8680
7	0.150	1,111	5780
8	0.200	1,146	700
9	0.300	1,082	-640

Max Slope:	8920
Avg Slope:	8660
Y Intercept:	-46.6667
X Offset:	0.005389
Pent. Corr:	0.105389
Corr. Load:	866
Slope CBR:	29
Data Slope:	5780
Data Y Inter:	244
Data Load:	853
Data CBR:	36
Corrected CBR:	28.9

swells% -.0.22



Molding Moisture Content: 10.3%
Molding Dry Density: 113.0 pcf
Estimated Post-Soak Moisture Content: 17.5%

Respectfully Submitted,
Construction Testing & Inspection, Inc.

Paul C Martin
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Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

CTI

Construction Testing & Inspection, Inc.

AASHTO T-180 METHOD "D"
COMPACTION TEST MODIFIED PROCTOR WORKSHEET
MOLD VOLUME 1/13.33 CF

FM 1-T180
Form #09-10-2021

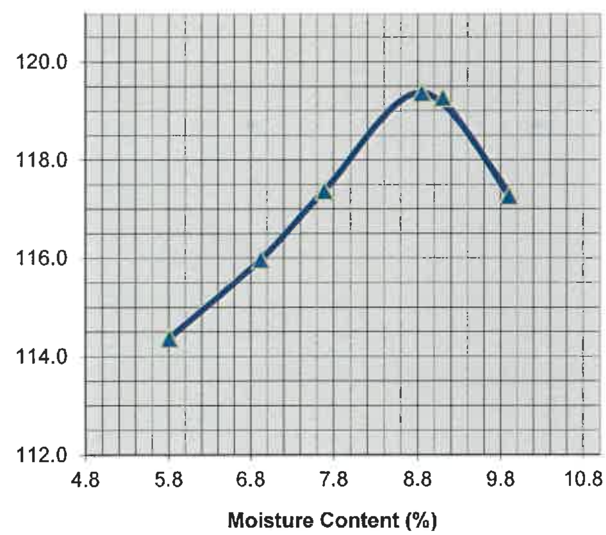
PROJECT NO. RUNWAY 9L-27R REH TESTED BY: L12642158-000 PEN. BY L12642158-000
CLIENT TERRACON/11684 LOCATION OPA-LOCKA AIRPORT
MATERIAL NO. 200/CBR DATE COMPACTED 10/22/2021
SAMPLE NO. #1 B-15 B-28 MATERIAL DESCRIPTION Light Tan Sand with rocks
SAMPLED BY Sampled by Client LAB NO S210378

MOISTURE CONTENT	5.8	6.9	7.7	8.8	9.9	9.1
PAN NO.	**16**	**17**	**18**	**19**	**20**	
PAN & WET SOIL	**978.4**	**975.1**	**979**	**975.6**	**982.6**	**950.7**
PAN & DRY SOIL	**946.7**	**937.1**	**938**	**929.0**	**930.4**	**904.7**
WT OF WATER	31.7	38.0	41.0	46.6	52.2	46.0
WT OF PAN	**400.9**	**388.1**	**404.6**	**402.3**	**402.5**	**401.4**
WT OF DRY SOIL	545.8	549.0	533.4	526.7	527.9	503.3

MOLD NO	**371**	**371**	**371**	**371**	**371**	
WET WT. + MOLD	**15.252**	**15.474**	**15.656**	**15.919**	**15.846**	**25.629**
WT OF MOLD	**6.177**	**6.177**	**6.177**	**6.177**	**6.177**	**15.866**
WET WT.	9.075	9.297	9.479	9.742	9.669	9.763
WET UNIT WT	121.0	124.0	126.4	129.9	128.9	130.2
DRY UNIT WT.	114.4	116.0	117.4	119.4	117.3	119.3

Maximum Density	Optimum Moisture
119.4	**8.8**

Moisture-Density Relationship



Plastic Index	Remarks	Soil Classification M-145- T88
NP		**N/A**

Organic Results FM1-T267		Gradation (T-27)	
Crucible #1	**N/A**	Range	Results
Crucible #2	**N/A**	(3-1/2") 100	**N/A**
Crucible #3	**N/A**	(3/4") 70 - 100	**N/A**
Average	**N/A**	(4) 30 - 100	**N/A**
		(40) 15 - 100	**N/A**
(T-11) % Passing 200 sieve		(100) 5 - 65	**N/A**
N/A		(200) 0 -15	**N/A**

Respectfully Submitted,
Construction Testing & Inspection, Inc.

Paul C Martin
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Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

CTI Construction Testing & Inspection, Inc.

California Bearing Ratio Test
Data Sheet

Form #09-10-

Client:	TERRACON/11684
Project No:	RUNWAY 9L-27R REH
Sample Description:	Light Tan Sand with rocks
Sampled By	Sampled by Client

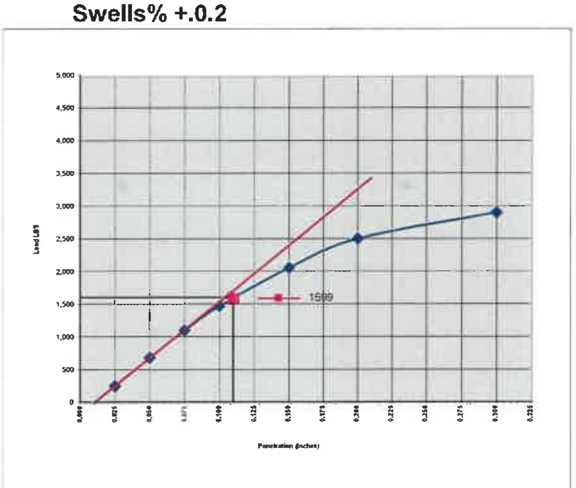
Tested By:	L12642158-000
Date Compacted:	10/22/21
Date Penetrated:	10/26/21
Sample No.	#1 B-15 B-28
Lab No.	S210378

Count	X Penetration In.	y Load LBS.	Slope Y\X
2	0.025	267	10680
4	0.050	698	17240
5	0.075	1,116	16720
6	0.100	1,488	14880
7	0.150	2,071	11660
8	0.200	2,516	8900
9	0.300	2,918	4020

Max Slope:	17240
Avg Slope:	17240
Y Intercept:	-164
X Offset:	0.009513
Pent. Corr:	0.109513
Corr. Load:	1724
Slope CBR:	57
Data Slope:	11660
Data Y Inter:	322
Data Load:	1599
Data CBR:	67
Corrected CBR:	57.5

Molding Moisture Content: 8.8%
Molding Dry Density: 119.4 pcf
Estimate Post-Soak Moisture Content: 14.5%

Swells% +.0.2



Respectfully Submitted,
Construction Testing & Inspection, Inc.

Paul C Martin
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Paul Martin, P.E., State of Florida #65051, CA Lic No. 26822

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CTI Construction Testing & Testing, Inc.

SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client: TERRACON/11684

Project No.: 11684
Test No.: #1 B-15 B-28
Tested by: L126421158-000
Date Tested: October 21, 2021
Lab No.: S210378

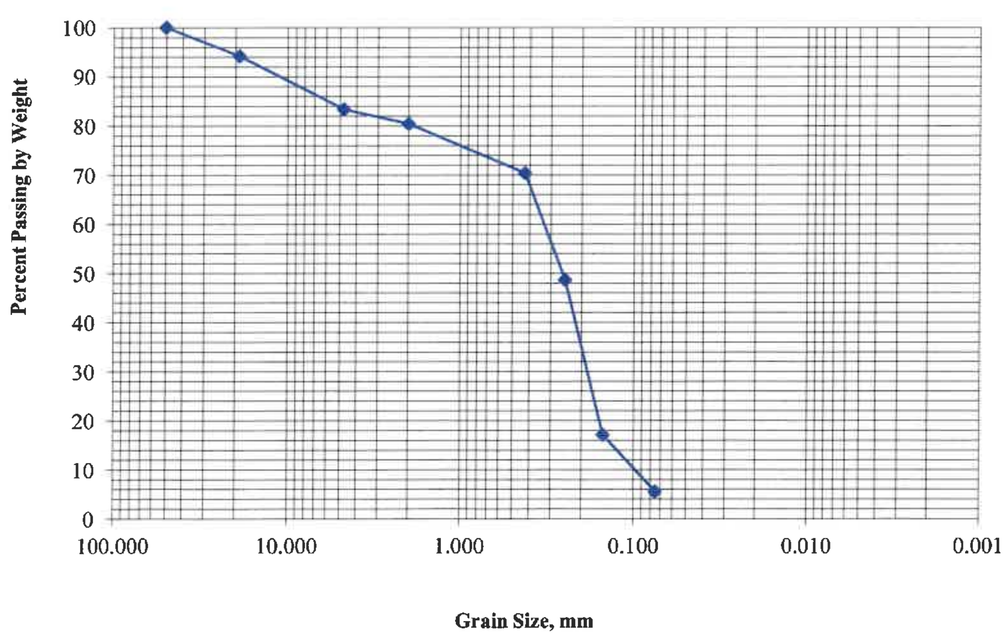
Project: Runway 9L-27R REH

Location: Opa-Locka Airport

Material: Light pale brown sand w/rock

Sieve No.	Sieve Opening mm	Percent Retained	Percent Passing
2"	50.000	0.0	100.0
3/4"	19.000	5.9	94.1
No. 4	4.750	16.7	83.3
No. 10	2.000	19.6	80.4
No. 40	0.425	29.6	70.4
No. 60	0.250	51.4	48.6
No. 100	0.150	82.9	17.1
No. 200	0.075	94.4	5.6
No. 230	0.063	97.2	2.8

Grain Size Analysis

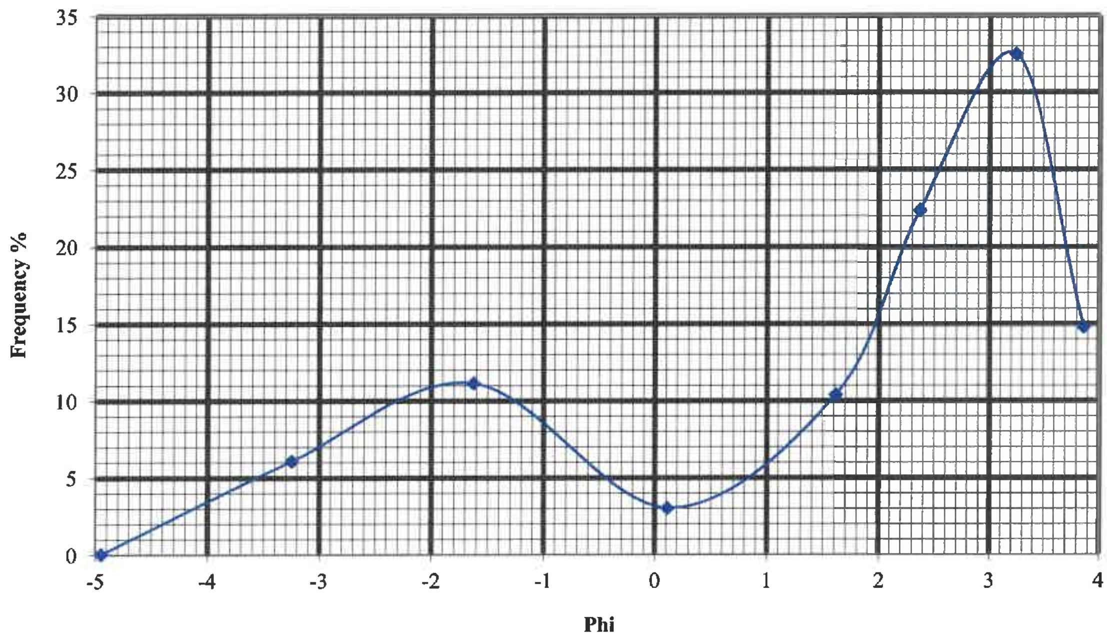


SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client:	TERRACON/11684	Job No.:	11684
Project	Runway 9L-27R REH	Test No.:	#1 B-15 B-28
Sample	Opa-Locka Airport		
Description:	Light pale brown sand w/rock		

		Mean Grain Size (mm)	0.260
No. 4 to No. 230 Sieve	80.6 %	Mean Grain Size (Phi)	1.94
		Sorting σ (Phi)	2.070
Munsell Color Wet	10YR 7/3	Percent Silt	0.0
Percent Passing #200	5.6 %	Percent > No. 4	16.7

Frequency



The gradation was performed in accordance with AASHTO T27 as requested by the client. The mean grain size calculations were performed using those sieves and not the phi sieves normally used.

Distribution:

Client - 2

Reviewed by:

CTI Construction Inspection & Testing, Inc.

Paul C Martin
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Paul C. Martin, P. E.
Florida Registration No. 65051

CTI

Construction Testing & Testing, Inc.

SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client: TERRACON/11684

Project No.: 11684
Test No.: #2 B-2 B-3
Tested by: L126421158-000
Date Tested: October 22, 2021
Lab No.: S210378

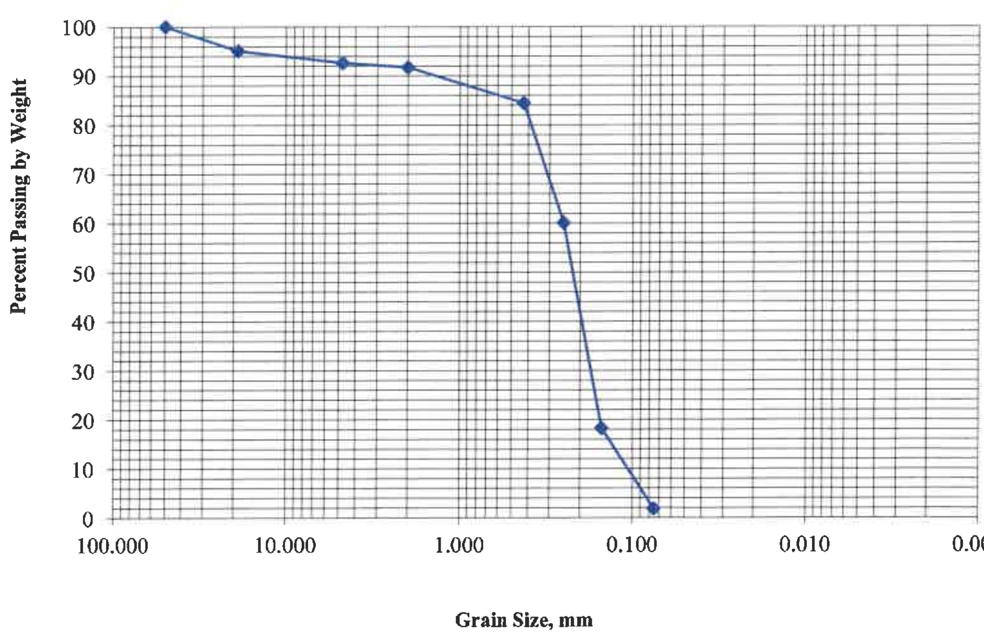
Project Runway 9L-27R REH

Location: Opa-Locka Airport

Material Dark gray fine sand

Sieve No.	Sieve Opening mm	Percent Retained	Percent Passing
2"	50.000	0.0	100.0
3/4"	19.000	4.9	95.1
No. 4	4.750	7.4	92.6
No. 10	2.000	8.3	91.7
No. 40	0.425	15.6	84.4
No. 60	0.250	39.9	60.1
No. 100	0.150	81.8	18.2
No. 200	0.075	98.2	1.8
No. 230	0.063	99.2	0.8

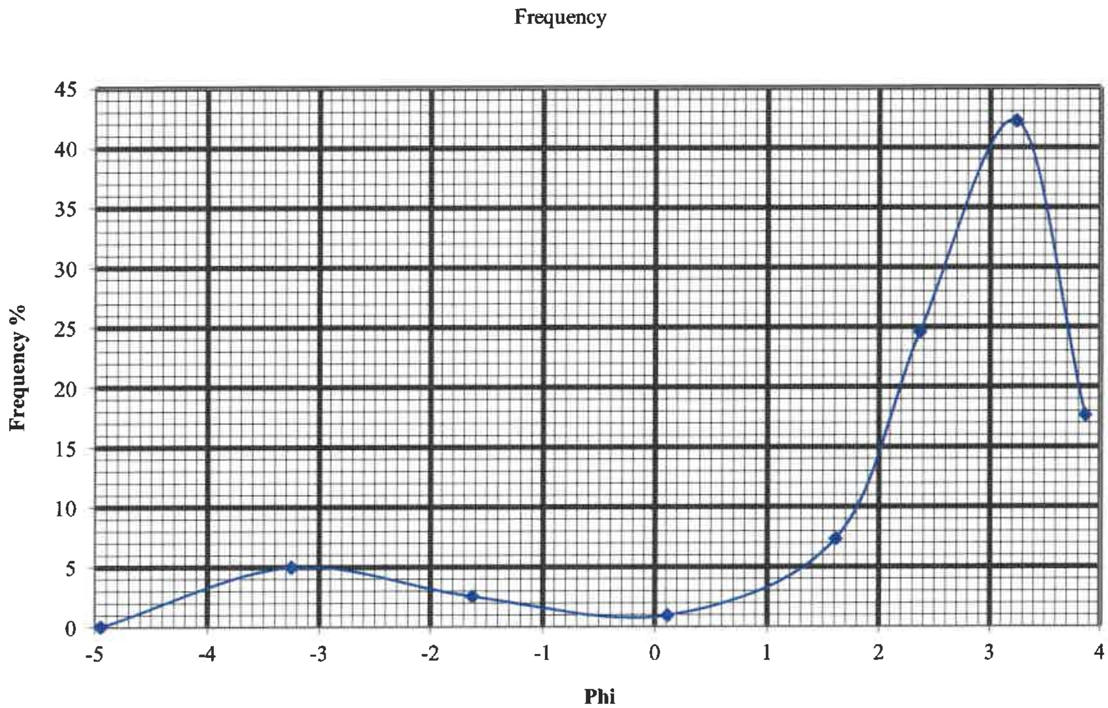
Grain Size Analysis



SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client:	TERRACON/11684	Job No.:	11684
Project	Runway 9L-27R REH	Test No.:	#2 B-2 B-3
Sample	Opa-Locka Airport		
Description:	Dark gray fine sand		

		Mean Grain Size (mm)	0.171
No. 4 to No. 230 Sieve	91.8 %	Mean Grain Size (Phi)	2.55
		Sorting σ (Phi)	1.654
Munsell Color Wet	10YR 5/1	Percent Silt	0.0
Percent Passing #200	1.8 %	Percent > No. 4	7.4



The gradation was performed in accordance with AASHTO T27 as requested by the client. The mean grain size calculations were performed using those sieves and not the phi sieves normally used.

Distribution:

Client - 2

Reviewed by:

CTI Construction Inspection & Testing, Inc.

Paul C Martin
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Paul C. Martin, P. E.
Florida Registration No. 65051

CTI

Construction Testing & Testing, Inc.

SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client: TERRACON/11684

Project No.: 11684
Test No.: #3 B-6 B-22
Tested by: L126421158-000
Date Sampled: October 21, 2021
Lab No.: S210378

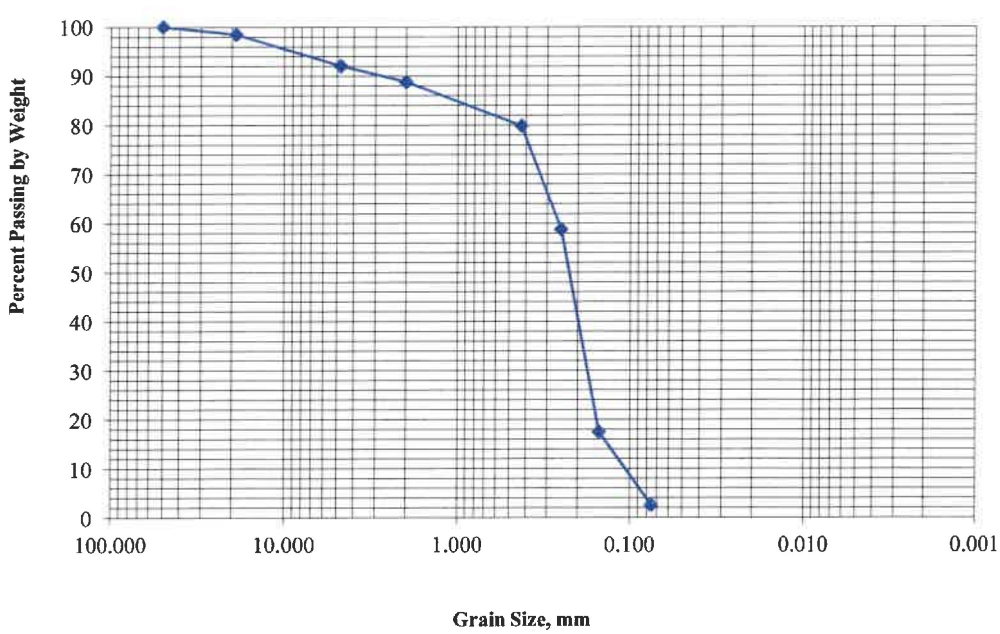
Project Runway 9L-27R REH

Location: Opa-Locka Airport

Material Gray fine sand w/rock

Sieve No.	Sieve Opening mm	Percent Retained	Percent Passing
2"	50.000	0.0	100.0
3/4"	19.000	1.6	98.4
No. 4	4.750	8.0	92.0
No. 10	2.000	11.2	88.8
No. 40	0.425	20.2	79.8
No. 60	0.250	41.3	58.7
No. 100	0.150	82.5	17.5
No. 200	0.075	97.5	2.5
No. 230	0.063	98.7	1.3

Grain Size Analysis

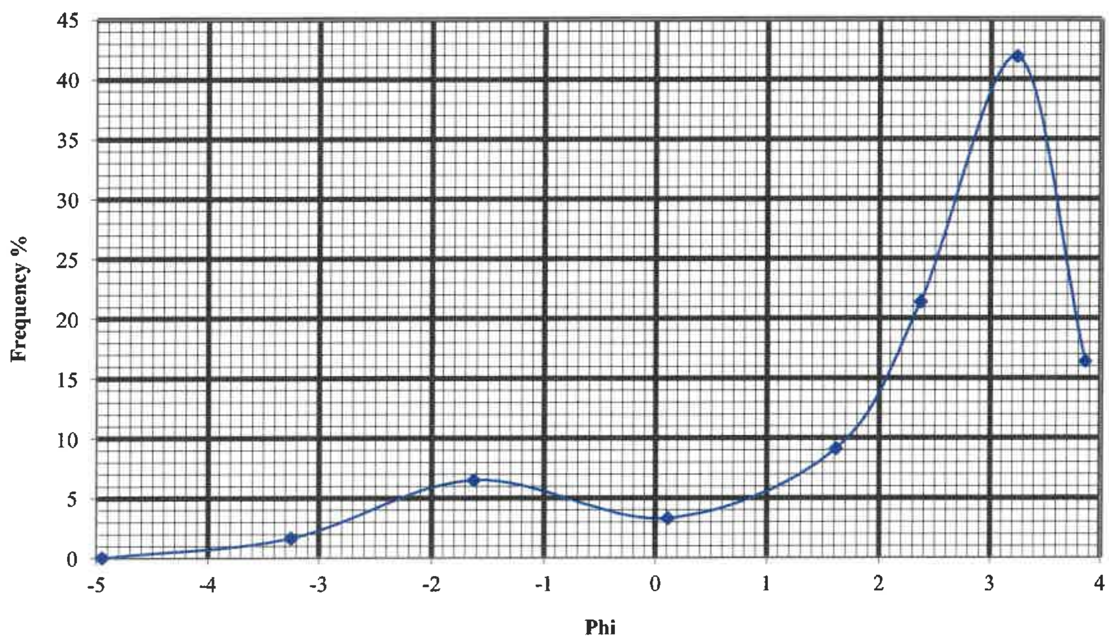


SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client:	TERRACON/11684	Job No.:	11684
Project	Runway 9L-27R REH	Test No.:	#3 B-6 B-22
Sample	Opa-Locka Airport		
Description:	Gray fine sand w/rock		

		Mean Grain Size (mm)	0.178
No. 4 to No. 230 Sieve	90.7 %	Mean Grain Size (Phi)	2.49
		Sorting σ (Phi)	1.559
Munsell Color Wet	10YR 6/1	Percent Silt	0.0
Percent Passing #200	2.5 %	Percent > No. 4	8.0

Frequency



The gradation was performed in accordance with AASHTO T27 as requested by the client. The mean grain size calculations were performed using those sieves and not the phi sieves normally used.

Distribution:

Client - 2

Reviewed by:

CTI Construction Inspection & Testing, Inc.

PAUL C. MARTIN LICENSE No 65051 STATE OF FLORIDA PROFESSIONAL ENGINEER

Paul C Martin
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Paul C. Martin, P. E.
Florida Registration No. 65051

CTI

Construction Testing & Testing, Inc.

SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client: TERRACON/11684

Project No.: 11684
Test No.: #4 B-1 B-2
Tested by: L126421158-000
Date Tested: October 22, 2021
Lab No.: S210378
Page 1 of 2

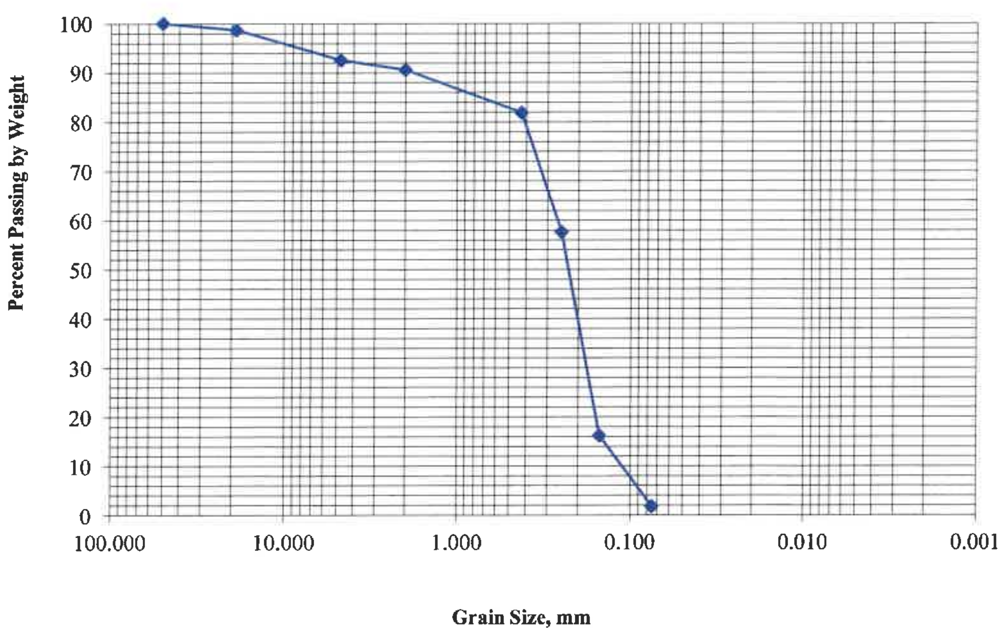
Project Runway 9L-27R REH

Location: Opa-Locka Airport

Material Light gray fine sand

Sieve No.	Sieve Opening mm	Percent Retained	Percent Passing
2"	50.000	0.0	100.0
3/4"	19.000	1.3	98.7
No. 4	4.750	7.5	92.5
No. 10	2.000	9.4	90.6
No. 40	0.425	18.1	81.9
No. 60	0.250	42.5	57.5
No. 100	0.150	83.8	16.2
No. 200	0.075	98.2	1.8
No. 230	0.063	99.1	0.9

Grain Size Analysis



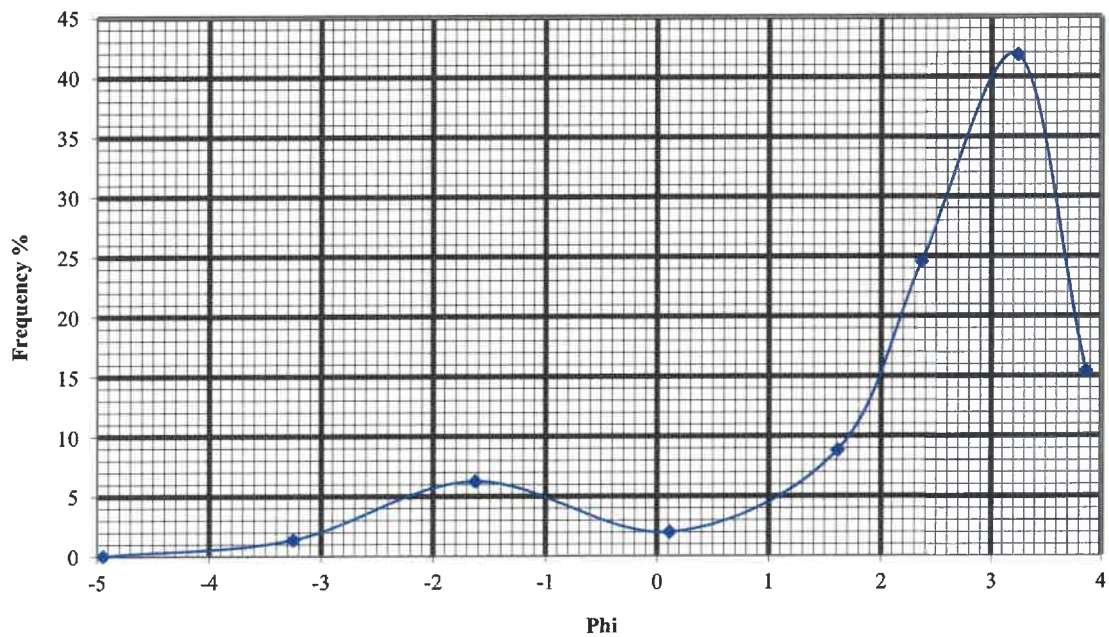
SIEVE ANALYSIS PHI MEAN AND PHI STANDARD DEVIATION OF GRAIN SIZE

Client:	TERRACON/11684
Project	Runway 9L-27R REH
Sample	Opa-Locka Airport
Description:	Light gray fine sand

Job No.: 11684
Test No.: #4 B-1 B-2

		Mean Grain Size (mm)	0.173
No. 4 to No. 230 Sieve	91.6 %	Mean Grain Size (Phi)	2.53
		Sorting σ (Phi)	1.483
Munsell Color Wet	10YR 7/2	Percent Silt	0.0
Percent Passing #200	1.8 %	Percent > No. 4	7.5

Frequency



The gradation was performed in accordance with AASHTO T27 as requested by the client. The mean grain size calculations were performed using those sieves and not the phi sieves normally used.

Distribution:

Client - 2

Reviewed by:

CTI Construction Inspection & Testing, Inc.

PAUL C. MARTIN LICENSE No 65051 STATE OF FLORIDA PROFESSIONAL ENGINEER

Paul C Martin
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic devises.
2021.11.24 13:15:33 -05'00'

Paul C. Martin, P. E.
Florida Registration No. 65051

INDIRECT TENSILE STRENGTH RESULTS

TEST REPORT

AASHTO ACCREDITED

Asphalt Testing Solutions & Engineering, LLC

Advancing the industry through EXPERTISE, QUALITY and COMITTMENT!

October 29, 2021

Terracon.
16200 NW 59th Ave. Ste. 106
Miami Lakes, FL 33014
Project: TERR 03-02

Attn: Guillermo Maya

Objective: Evaluate the provided FAA cores for ASTM D6931 (Indirect Tensile Strength).

Notes

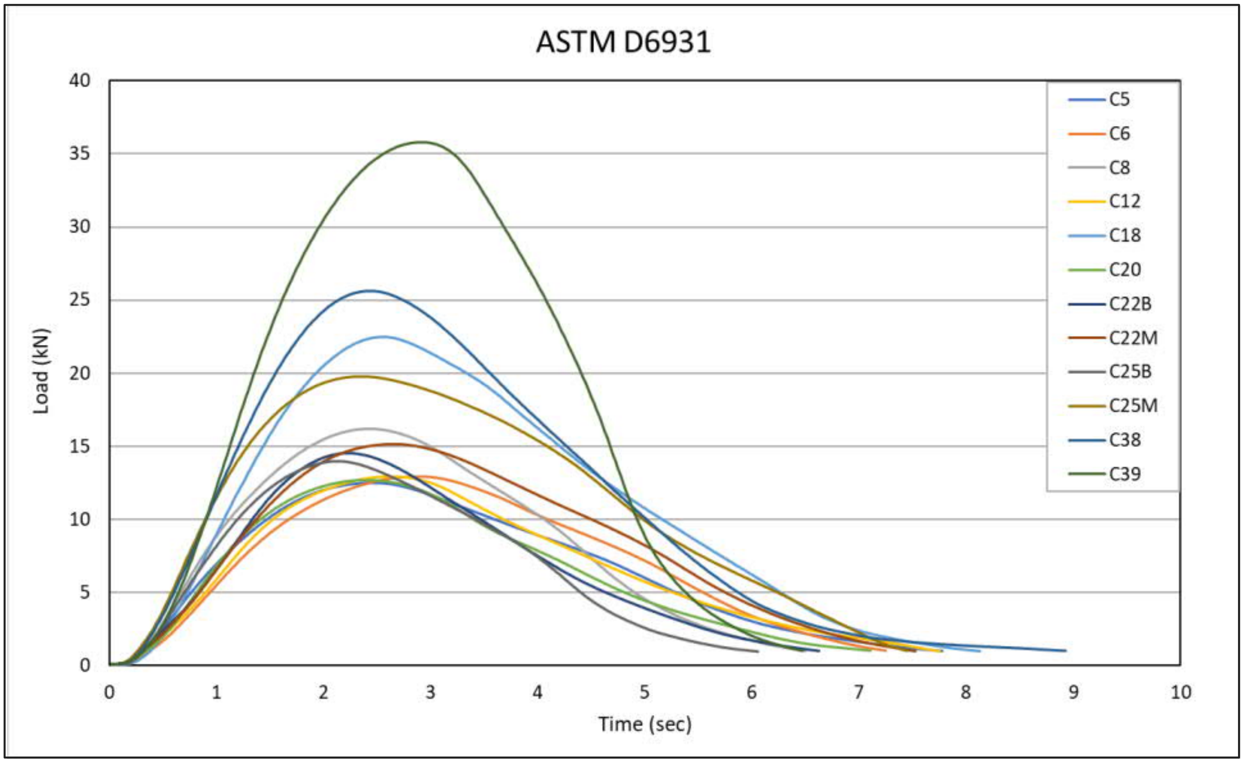
Core ID	Notes
C-05	Core was cracked through top two layers into third. Technician trimmed top of core ¼" from crack and tested requested depth below.
C-06	Core had 3" top-down cracking. Technician trimmed top of core ¼" from crack and tested requested depth below.
C-08	Core had approximately 1 ½" top-down cracking. Technician trimmed top of core ¼" from crack and tested requested depth below
C-12	Core was trimmed ¼" from bottom of top-down cracking. Tested requested depth below.
C-18	Core had approximately 3" of top-down cracking. Technician trimmed top of core ¼" from crack and tested requested depth below
C-20	Core had approximately 2 ½" of top-down cracking. Technician trimmed top of core ¼" from crack and tested requested depth below
C-22	Technician was informed of a crack and measured approximately ¼" from a crack on the top of the specimen. An approximate 3 ½" sample was cut from the center section and then tested (C-22 M). Technician also measured approximately 3" from bottom of core, the core measured to be only 2.8". Proceeded testing core as-is (C-22 B)
C-25	Technician was informed of a crack and measured approximately ¼" from a crack on the top of the specimen. An approximate 3 ½" sample was cut from the center section and then tested (C-25 M). Technician also measured approximately 3" from bottom of core, the core measured to be only 2.9". Proceeded testing core as-is (C-25 B).
C-36	Technician trimmed bottom of core, tested as-is.
C-38	Technician trimmed bottom of core, tested as-is.

Measurements

Core ID	Test Method	Average Thickness, mm	Average Diameter, mm
C-05	ASTM D3549 (Method A) 25°C 4hr	90	149
C-06		91	149
C-08		93	149
C-12		89	149
C-18		90	149
C-20		91	149
C-22 (M)		87	149
C-22 (B)		72	149
C-25 (M)		91	149
C-25 (B)		76	149
C-36		87	150
C-38		79	150

Test Results

Core ID	Test Method	Maximum Load. N	IDT Strength, kPa
C-05	ASTM D6931	12,490	600
C-06		12,900	610
C-08		16,190	750
C-12		12,930	620
C-18		22,500	1,080
C-20		12,650	600
C-22 (M)		15,120	740
C-22 (B)		14,520	860
C-25 (M)		19,760	930
C-25 (B)		13,970	790
C-36		25,640	1,250
C-38		35,800	1,920



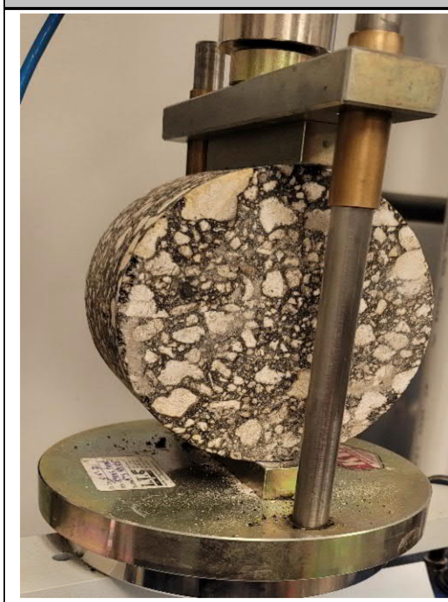
Tested By: ______________________________
Alex Coleman, Performance Lab Technician

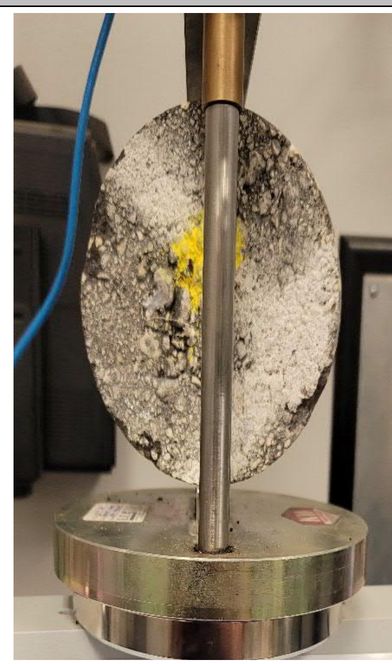
Date: October 29, 2021

Reviewed by: ______________________________
Dawson Padgett, Performance Lab Manager

Date: October 29, 2021

APPENDIX

Trimmed Samples Prior to Testing		
C-05	**C-06**	**C-08**
		
C-12	**C-18**	**C-20**
		

Trimmed Samples Prior to Testing		
C-22 (M)	**C-22 (B)**	**C-25 (M)**
		
C-25 (B)	**C-36**	**C-38**
		

SUPPORTING INFORMATION

General Notes
Unified Soil Classification System (USCS)

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

- Auger Cuttings
- Rock Core
- Grab Sample
- No Recovery
- Shelby Tube
- Standard Penetration Test

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(DCP)	Dynamic Cone Penetrometer
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% of more passing the No. 200 sieve) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Automatic Hammer SPT N-Value (Blows/Ft.)**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Automatic Hammer SPT N-Value (Blows/Ft.)**
Very Loose	< 3	Very Soft	Less than 500	< 1
Loose	3 – 8	Soft	500 to 1,000	1 – 3
Medium Dense	8 – 24	Medium Stiff	1,000 to 2,000	3 – 6
Dense	24 – 40	Stiff	2,000 to 4,000	6 – 12
Very Dense	> 40	Very Stiff	4,000 to 8,000	12 – 24
		Hard	> 8,000	> 24

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobble	12 in. to 3 in. (300 mm to 75 mm)
Gravel	3 in. to #4 sieve (75 mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other consituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Particle Size
Non-Plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**Group Name** [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.